Pythagoras 12.00

Pythagoras

The standard for both surveyors and civil engineers

Pythagoras

Manuel de Référence

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Pythagoras CAD+GIS V12 Reference Guide

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PART I Concepts and terminology

Working with Pythagoras requires understanding certain concepts and terms. This section describes the concepts and special terms required to understand this manual and to work with Pythagoras.

Chapter 1: Coordinate Systems

Pythagoras supports 5 types of coordinate systems. It is important to understand the different principles behind each of the coordinate systems in order to use them correctly.

These 5 Coordinate System types are:

1. The Local Coordinate System
2. The Global Coordinate System
3. User Coordinate Systems
4. The Page Coordinate System
5. The Temporary Coordinate System

To express coordinates, Pythagoras supports the following conventions:

- XYZ: rectangular coordinates expressed in a XYZ (horizontal X-axis) coordinate system.
- NEZ: rectangular coordinates: North, East, Elevation (Z).
- HDZ: polar coordinates: Horizontal angle, Distance (horizontal), Elevation (Z).
- HVD: Horizontal angle, Vertical angle, Distance (horizontal).
- HVS: Horizontal angle, Vertical angle, Slope Distance.
- CDZ: Centerline (station) distance, Distance from the Centerline (perpendicular to the centerline), Elevation.

In the Local, Global and User coordinate systems you can enter coordinates or obtain positions in any of the above-described conventions. At any moment you can switch between the above-described conventions, as will be explained later.

Defaults:

a) Definition of the reference axis. Both XYZ (horizontal x-axis) and NEZ (North(Y)-East(X)) are supported. Default: NEZ.
b) Length unit: can be set to meter, millimeter, centimeter, kilometer, miles, feet of US feet. Default: meter.
c) Angle unit: GON (GRAD), Degrees, Radians or Mil. Default: GON.
d) Angle direction: clockwise or anticlockwise. Default: clockwise.
e) Elevation: (Z) corresponds with our natural feeling of elevation; higher positions result in larger values. When using the HVS or HVD system, the vertical angle is either zenith based (100 GRAD = horizontal) or elevation based.

The default units of measurement for the values shown above may be changed at any time. If you select a new default for a given value, the new default remains in effect even if you quit Pythagoras or switch off your computer.

Coordinate Reference Systems

A Coordinate Reference System (CRS) is a specification of:

(1) a Geographic Coordinate System and
(2) a Map Projection System,

so that any point on the earth can be represented on a flat surface. The Geographic Coordinate System is defined by an ellipsoid and the datum (= definition of the origin and the orientation).

Together these two parts are necessary and sufficient to define a framework for locating unambiguously and precisely every point on land or sea within a certain region. There are hundreds of different geodetic datums and projection systems used in the modern world, depending on the specific area and goal of usage. More information you can find under following links:

- Geographic coordinate systems: http://en.wikipedia.org/wiki/Geographic_coordinate_system
- Map projections: http://en.wikipedia.org/wiki/Map_projection
- Coordinate reference systems and positioning: http://en.wikibooks.org/wiki/Coordinate_Reference_Systems_and_Positioning
- Information and Service System for European Coordinate Reference Systems: http://www.crs-geo.eu

Pythagoras supports over 50 predefined Coordinate Reference Systems used in particular country or region and UTM (a worldwide system), such as

- UTM (based on WGS84)
- Lambert72 Belgium
- Lambert2008 Belgium
- RD (Rijksdriehoeksnet) Netherlands
- GK (4 zones) in Germany

Coordinates for these systems are represented in XY coordinate system. Geographical coordinates (Latitude, Longitude) in WGS 84 are also supported. The number of CRSs in Pythagoras will extend with coming demand and available information.

Pythagoras provides you with tools for

- use of data from different CRSs in the same drawing, e.g., adding data of an old drawing in Lambert 72 to a new project in UTM Z31
- converting a drawing from one CRS to another, e.g., converting a drawing in Lambert 72 to a drawing in Lambert 2008
- converting geographic longitude and latitude coordinates into Cartesian coordinates, e.g., importing data from shape file in WGS84 in a drawing in Lambert 2008
- real-time conversion of positions in a drawing into a wide range of other possible CRSs or geographic coordinates, e.g., in a drawing which is originally in Lambert72, showing the coordinates of the mouse position in longitude, latitude in WGS84

There are certain limitations you should consider when changing from one CRS to another:

- Only one CRS can be active in a drawing at a time
- Every CRS has a limited domain that gives high accuracy points, and even a limited domain where the projection can be used. So after switching to another CRS, the data in the drawing can become meaningless or be converted with loss of accuracy. During import and paste operations, objects outside the range of the current CRS can be lost.

Tie Points

High accuracy transformations are possible between some systems based on Tie Points: If n points are known precisely in CRS_1 and in CRS_2, Pythagoras will use this data (set of Tie Points) to enhance the precision for other points in the same region.

Let us assume there is a set of points known exactly in two Coordinate Reference Systems: GK 2 and UTM. For this set of points Pythagoras will do a series of calculations so that a coordinate not included into the original set can be accurately converted from GK2 to UTM. The original set is called Tie Points Set.

The last calculation is a Helmert transformation. It gives a translation (dx, dy), a rotation (Fi), and a scale factor for the conversion. And for each point in the set we receive a residual (fx, fy). Residual is the difference between the UTM coordinate given in the set and the UTM coordinate derived from the transformation.

Here are the steps performed for a point (xy) to convert it from GK_2 to UTM using a set of tie points:

1. Transformation of the point xy from GK_2 to UTM --> point xy'
2. Helmert Transformation (for given Tie Points set) of the point xy' --> xy''
3. Smoothing residuals

In Pythagoras, residuals can be of the following kind:

- No smoothing residuals: no further corrections needed
- Inverse Distance Weighting (1/Square Distance or $1/s^2$): the value at the point is a weighted sum of the values of N Tie Points
- Natural Neighbours by Area (NN Area): interpolating over the changes in area between the point and its Natural Neighbours from the set of Tie Points

You can import Tie Points sets into Pythagoras library with the help of Tie Points Manager (see PART II → Chapter 1: → Tie Points). The ASCII file with a tie points set has a special format. This format depends on the units of Pythagoras and the coordinate order (NE/XY) on the moment of reading the file. Tie point sets can only be defined between projection systems; geodetic coordinates (like WGS84) can not be used.

The format of the tie points set resembles the coordinate list format. The data of each tie point must be put in one line of text containing:

<PointId><separator>
<first coordinate in Projection system 1><separator>
<second coordinate in Projection system 1><separator>
<first coordinate in Projection system 2><separator>
<second coordinate in Projection system 2>

Tab or space(s) can be used as delimiter. Real values can have a point or a comma as decimal point. A comment can be added in the file using ":" or ";" in front of it.

For UTM coordinates the format of the coordinates must also fit the Long/short/no prefix settings of the preferences.

You can manage the settings of tie points transformations via ‘Select Coordinate Reference System’ dialog. Please refer to PART II → Chapter 5: → Set Coordinate Reference System.

The Local Coordinate System

This is the basic coordinate system you use most of the time when starting a new drawing. The Local Coordinate System usually corresponds with the local coordinate system you used in the field to measure the survey information. The position of the first station will normally correspond with the origin of the Local coordinate system and the reference direction (Hor. Angle = 0.0) will correspond with the x-axis or north-axis (depending on the preference XY or NE) of the Local coordinate system.

As will be explained later, you can position the drawing anywhere on the Local coordinate system. You can rotate the page, move it up or down and scale it. You can change this at any time, so that you are able to rotate the drawing and select the most appropriate scale in order to make the drawing fit on the page.

The Global Coordinate System

The Global Coordinate System is typically used when you want to use (or convert to) a standardized coordinate system with large X and Y values (e.g. State Plane or UTM coordinates).

You need to know the coordinates of at least two common points in both the local and the global coordinate system.

The coordinate system conventions described above are valid for the global coordinate system with the exception that polar coordinates cannot be used. A more detailed description will be provided in the section on transformation.

User Coordinate Systems

You can easily define new coordinate systems. They are called User coordinate systems (UCS), and you can define up to 32 in one drawing. A UCS can be removed if you only require it temporarily. When measured coordinates are entered manually, a new station point will correspond with a new user coordinate system. In order to define a user coordinate system, it is sufficient to know the origin and a point on the reference direction. The coordinate system conventions described above apply to user coordinate systems.

At any time you can switch between the local coordinate system and any defined user coordinate system. The control panel data will always correspond with the selected coordinate system. This is true for both data input, as well as for displayed information.
This way, the coordinates of any point of your drawing can be obtained in any of the defined coordinate systems, and in either XYZ, NEZ, HDZ, HVD, HVS or CDZ coordinates.

Note: The elevation of points in a User coordinate system is relative to the elevation of the origin of the User coordinate system.

The Page Coordinate System

This coordinate system is not related to the survey data. The page coordinate system is used to draw information, which is not bound to the survey plan. This can be simple things, like drawing a border around the drawing, but also complex drawings not related to the survey data (for example the section of a road foundation) are made in the Page Coordinate System.

The origin of the page coordinate system is the bottom left corner of the page, and the x-axis corresponds with the bottom edge of the page. The position of the information defined in page coordinates remains fixed, even if you change the position, rotation or scale of the local coordinate system.

The scale factor used in page coordinates can be changed any time. This allows you to draw information in different scales on the same drawing. Once you set a scale factor, this applies to all elements defined in page coordinates.

Note that while objects defined in the local coordinate system and in the page coordinate system are on the same drawing, there is no link between them.

The Temporary Coordinate System

You can create one Temporary Coordinate System in a drawing.
The temporary coordinate system is not stored in the document. An existing temporary coordinate system is automatically replaced when you create a new one.

A temporary coordinate system can be created either in the Local Coordinate System or in the Page Coordinate System.
When created in a document, all rules relating to User Coordinate Systems also apply to the temporary coordinate system.
When a temporary coordinate system is created in the Page Coordinate System, input and output in the control panel is relative to the temporary coordinate system. The origin is 0,0 and coordinates depend on the actual scale of the page coordinates.

Chapter 2: Basic Concepts

Snapping

Pythagoras will snap to a line, a point, an arc, a circle or the center of a polygon when the mouse is about 2 mm. from the object. This snapping is clearly indicated on the screen. An indication called "the Sight" will be displayed on the object. The shape of the Sight depends on the type of object it refers to. In the control panel you will see information about the object in the Sight.

When creating lines, arcs or circles, other snapping symbols may appear to indicate that objects are tangential or perpendicular.

Snapping can be turned on or off. Using the Defaults Menu, the snapping can be turned on or off for each type of object. A toolbox that allows to view and change the status of snapping to specific object types can be activated via View Menu -> Toolbars.

Point Number

A Point Number is the unique name allocated to a point. Every point in a Pythagoras document has an 8-character long identifier. Valid identifiers are: 1, 1050, A point, Point 1, S1.

Pythagoras does not associate any meaning to the name allocated to a point. The point number is either allocated by the user, or is allocated automatically by Pythagoras when a new point is created. A start point for automatically incrementing point numbers can be set at any time. See also PART II → Chapter 5: Document Defaults for details.

Subdocuments

Subdocuments allow you to create drawings that contain billions of objects while maintaining good processing speed.

From time to time it is handy to be able to link a number of documents as if they were one large drawing, e.g. assembling the details of different parts of a city into one large city plan drawing. At other times it is handy to use a base-plan as background to a drawing. Either way, subdocuments provide you these opportunities.

You can link multiple (large) documents with one another, especially if the documents are too large to use the traditional copy and paste method of putting them together. The result is that on the screen, it appears as if all these linked drawings were one gigantic drawing. By the way, combining these drawings using the more traditional copy and paste method may result in a drawing that has become unmanageable.

All the subdocuments of the drawing are saved with relative names, i.e., the name includes path to the subdocument relative to the main drawing. We recommend that you store your subdocuments in the same directory and subdirectories to avoid loosing them when copying or moving your drawings to another location.

Pythagoras allows you to link together an enormous amount of subdocuments. You can set any of them editable or only visible, or sleeping (invisible), and choose to save or not these settings with the document. Only one subdocument at a time can be active, which means that new objects will be created in this subdocument. Only a visible and editable subdocument can be set active.

Be careful while working with Coordinate reference systems in subdocuments. When a CRS is defined for the main document, the subdocuments should have the same CRS or should have no CRS at all. In any case, the local coordinates of the main document and subdocuments must match.

To make your work with a large number of subdocuments easier, we introduce a new concept: subdocuments configuration. After setting all the required documents editable/visible/sleeping, you can store this configuration by giving it a name. You can have multiple subdocuments configurations in your drawing, and quickly change the set of visible and editable documents by switching to another configuration or by setting a configuration active in the current display view. For details, refer to Views and to PART II → Chapter 1: Subdocument Manager.

Layers

Layers are provided in Pythagoras to enable you to group related parts of your drawing. You can think of layers as a set of transparent overlays.

This version of Pythagoras supports up to 4096 layers. You can give a layer a name, and you can make a layer (or all layers) visible or invisible, protected or not-protected and active or non-active.
These attributes are assigned for every document.

In order to come to a better control of a large number of layers and to sort similar layers into logical units, Pythagoras offers you the possibility to create layer groups. These groups can also be renamed and deleted. You can always remove a layer from a group. A layer can belong to one or more groups, or belong to no group at all.

The advantage of such a group structure is that when you change the attributes of a group, the attributes of all the layers in that group will be changed. As a consequence the management of layers can be simplified enormously. So you can create layer groups as you want: e.g. topography, gas, water, electricity, etc.

You can add the following attributes to layers and to groups:

- Visible: determines whether the layers are visible or not
- Protected: no modification can be taken to such a layer
- Switch off: the objects of the layer will be shown, but they cannot be modified, or selected

Layers can be set up in a way that its information will only be visible between 2 scale factors. E.g.: the information is only visible between scales 1/10000

and 1/2000. Outside this range the objects of the layer are not visible. When no top limit is given, the layer will remain visible when zooming out and when no bottom limit is given the layer will remain visible when zooming in.

This feature is especially useful with very big drawings. To display a city map with all its details can take a while and will be chaotic. In this case you can manage the layers in a way that when opening your drawing only an overview will be displayed. When zooming in, more details will be shown. Eventually the overview disappears.

Because layers can have different meanings in different drawings, you must take care when exchanging data (Copy/paste, export/import) between drawings. We do recommend that you standardize your use of layers in order to avoid the need to change the layers of objects when you move data from one drawing to another.

Symbols / Line Styles / Patterns

Pythagoras provides you with tools to create your own symbols, line styles and polygon patterns. Once created and saved, these special features can be applied to any point, line, or polygon in your drawings.

Symbols, line styles and patterns can be scale dependent or scale independent. A scale dependent symbol/line style/pattern has real dimensions; the one that is not scale dependent, has dimensions that correspond with the size as it will be printed. In addition, symbols can be rotatable and North oriented; and patterns can have a Rotation angle.

Once created, symbols, line styles and patterns can be either placed in the library (the file "PYTHAGOR.LIB") or in the active drawing. Library symbols/line styles/patterns can be used in every existing and in every new drawing. A document symbol/line style/pattern can only be used in the active document. When it is copied and pasted in another document, it becomes automatically a document symbol/line style/pattern in the document into which it is pasted.

When creating symbols, line styles or patterns for the library, we suggest that you define them first as document symbols/line styles/patterns in the original drawing. This allows you to test them and to verify the printout before placing into the library.

Remarks:

- *PYTHAGOR.LIB: This file is stored in the same folder as the program Pythagoras. It is recommended to take regularly a backup of this file. If no backup is available and the PYTHAGOR.LIB file is lost, the complete library needs to be rebuilt.*
- *All symbols/line styles/patterns that are used in the drawing are stored in the document. This is the case both for document and library ones. If a document is opened, Pythagoras will first check if a symbol/line style/pattern defined in the document is in the library. If not, it will become a document symbol/line style/pattern, even if it previously was a library one. This could for example be the case if a library symbol/line style/pattern is deleted, or if it has been changed. This also means that drawings made by other Pythagoras users can be opened without the need to exchange libraries.*

The name of every symbol, line style or pattern consists of 2 parts: group and symbol. The combination Group-Symbol forms the real name of the symbol/line style/pattern. The subdivision in groups, for example a group

"Trees", makes that symbols/line styles/patterns can be selected faster in the menus.

Detailed instructions on how to create and customize your own symbol, line style or pattern you can find in PART II → Chapter 1: Symbols.

Compounds

Compound objects (or compounds) are collections (sets) of other CAD objects of a Pythagoras document. The latter CAD objects are called compound object elements. Unlike paths and polygons, elements are not ordered and cannot belong to the same compound more than once. A CAD object also cannot belong to more than one compound. A compound and all its elements must belong to the same overlay and subdocument; however elements may lie in different layers. Compounds themselves do not belong to any layer at all.

Note: Compounds are also called 'Groups' in Pythagoras.

Compound elements can be of any object type excluding coordinate system, road and other compound. Also a compound itself cannot be an element of other compounds, paths or polygons.

When you create a compound, if any of the selected objects are already elements of another group, Pythagoras will show a warning and suggest to

1. Exclude the objects from the groups they belong to and proceed with creating the compound.
2. Not include the elements of other groups into the created compound.
3. Abort grouping the objects into a compound.

Similarly, if you select the elements of more than one compound and try to ungroup them, Pythagoras will warn you and ask whether you really want to delete all the compounds.

A compound itself has no properties, but its elements keep their graphical attributes and can be changed individually. However, a compound has data attributes, i.e., it can be linked to a table as a separate object. In this case, each of its elements appears to have the same common data and cannot be linked to this or another table separately.

When you create a compound (a group), if any of the selected objects are linked to the database, Pythagoras will show a warning and suggest to

1. Unlink the objects from the database and proceed with grouping.
2. Not include the linked objects into the group.
3. Abort grouping the objects into a compound.

Similarly, if you try to delete a compound linked to the database, Pythagoras will warn you and unlink the compound from the database before ungrouping the objects.

Compounds are not clearly visible on the screen, but once you click on a compound element, all other elements of this compound will be also selected. On the contrary, when you select CAD objects using other means (cross-hair, lasso), only objects lying inside the region are selected. This can be used to select an element of a compound separately.

Information on creating and editing compounds you can find in PART II → Chapter 2: Group/Ungroup and Chapter 3: → Edit Group.

Images

In Pythagoras, an image can be a scanned drawing or a picture which you import into your drawing. Also files made or adapted by programs like Photoshop, Paintbrush, etc. can be imported.

Pythagoras reads files stored in Windows BMP (bitmap), TIFF, GeoTIFF, JPEG formats or stored in the Pythagoras image format. Scanned images that are not stored in one of these formats must first be converted into one of the formats above. BMP images may be monochrome, or contain 16, 256 or 24-bit colors. RLE compressed BMP files are NOT read by Pythagoras.

Scanned images can become very large. The size depends on the following:

- The color depth of the image: a monochrome image will take much less memory then a 24-bit color image.
- The resolution (dpi) of the scanned image.
- The size of the image.

For example an A4 color picture scanned at 300dpi and 24-bit color will result in a file of 26MB. When we scan the same image at 600dpi, the size will be 4 times larger. On the other hand an A0 black and white drawing scanned at 300 dpi will occupy uncompressed 17,4MB.

During the import, Pythagoras converts the BMP/(Geo)TIFF image to a Pythagoras image file. (Window's extension .IMG). This format is optimized in order to speed up the display of an image on the screen. (Zooming in, zooming out, scrolling, etc.). On average a black and white drawing will be about 5 times smaller. The typical size of a Pythagoras image file of a 300dpi A0 black and white drawing will be about 4MB.

Because a Pythagoras image can be very large, the image itself is not stored in the Pythagoras document. The document itself contains - in this instance-, in addition to general information about the image, a reference to the name and the location of the image file on the computer. Therefore it is important to save the Pythagoras image files with your drawing. If an image file is deleted, or if the name is changed, a message will appear when the document that refers to that image is opened. When the image file is still present on the computer, the new name or the new location can be given.

You can also include images directly into the drawing. The disadvantage, of course, is that the Pythagoras drawing will significantly increase in size. But the advantage is that the images are enclosed in the document, so if you, for example, move your document to another location or want to give someone a copy of it, your images will be automatically included and you do not have to worry about copying them too.

When editing images, these changes are stored in the Pythagoras file and not in the original image file. Thus, the original image file is not changed. However, you can, if needed, save the modified image as a new file with a new different file name (refer to a more detailed explanation in PART II → Chapter 1: Import Image).

A linked image can be used in multiple drawings. It is obvious that the image file is saved only once. It is for this reason that changes to images are saved separately from the image and that an image file cannot be overwritten.

When an image is linked to a document, the name of the Pythagoras image file will be the path and the filename relative to the path where the document is stored. For example, if the document is in ‘C:\MyDocs\Proj1’ and the linked image is in ‘C:\MyDocs\Proj1\Images’, then the image file ‘MyPic.jpg’

will be stored as ‘Images\MyPic.img’. We strongly recommend that you save the image file in the same directory as the drawing, or in a sub-directory.

Note1:
The GeoTIFF format is a variant on the TIFF-format. The content of geographical data in GeoTIFF-images is the main advantage. As a consequence it is possible to import images that are automatically geo-referenced.

Note2:
Pythagoras will georeference images if a "World File", e.g. .jpw, .tfw or .bpw exists in the same directory as the image file. The "World File" is a standard employed by such applications as ArcView and MapInfo.

There are two ways to import several images into your drawing: selecting one or multiple images in the ‘Open’ dialog or selecting a text file that contains a list of images. Please PART II → Chapter 1: Import for instructions.

After importing an image into your drawing, the properties of the image (scale, intensity, etc.), the position, as well as the image itself can be modified. Following operations can be done on images:

1. Selecting an image

An image can be selected by pressing the "B" or "I" on the keyboard while you click on the image. Subsequently the image may be moved or deleted.

2. Raster operations

If you need only a part of an image or you need to correct a part of an image, you can modify it with the following tools:

- Cut off
- Lasso
- Eraser

For more details, see PART II → Chapter 3: The Tools Menu.

3. Changing the attributes of an image

By double clicking on an image, a dialog box will appear displaying all relevant information about the image. In this dialog box the opportunity is given to save the modified image. The original can't be overwritten. For more information about this dialog box see PART II → Chapter 6: → Object Info.

4. Digitizing of images

By using a scanned image in the background, Pythagoras is an ideal tool for head-up digitizing. Mostly the purpose will be to obtain a drawing in real dimensions. Namely, a distance on the image, which is 1 meter in reality, should be 1 meter in the digitized drawing.

To obtain the right scale you need to execute the following steps:

1. Import the image in an empty drawing.
2. Set the scale of the drawing in accordance with the scale of the original.
3. Control the horizontal and vertical dimensions. Correct the size of the image by changing the image x- and/or y- scale factor, if either the horizontal or vertical dimensions are wrong because of stretch or shrink of the original.
4. When you want to work in a known coordinate system:
   Place points on the image at locations that you know in coordinates. Use subsequently the function "Helmert Transformation" to transform the complete drawing to the known coordinate system.

When you work in a known coordinate system, for example State Plane coordinates, you can use copy and paste in both directions between a

drawing with an image and other drawings using the same coordinate system. However if you would copy the image itself, the origin will be transformed but it will not be rotated.

When you are done editing your image object, you can export it again to an image file. To this time, the exported image can be stored in two formats: Windows BMP (bitmap) and JPEG. Exported images can retain the georeferencing by generating a BMPW or JPW file.

Display Levels

The level defines the display priority of the selected objects. A polygon of a house with level 1 gets a higher priority than a polygon of a land lot that has been given level 0. The house will be completely visible while the lot will partially be hidden.

Another example is the covering of partial areas of raster maps. If you want to hide some parts of a raster map, you can define a white opaque polygon. This polygon gets a 100% filling and a higher level. The polygon covers this area like a piece of paper that is placed over it. If you choose a specific layer for this polygon you can make the covered area visible at a later time by a simple selection and e.g. a change of color.

The range of display levels in Pythagoras varies from –10 to 10. We recommend that you carefully set display levels for your objects not to "loose" them in the drawing. You can also pre-set a default level for all new objects (see PART II → Chapter 4: → Display Level).

Views

A Display View is a collection of settings that control the way your drawing is displayed on the screen. If such a collection is named and saved, it is called a View.

Pythagoras allows you to create as many display views for your drawings as you wish, tuning the settings according to your needs. Once you have created a display view for a document, you can give it a name and store it, so it can be applied for other documents. You can also assign a view to a sheet, then this view will automatically become active when the sheet is selected. Independently of whether you have saved your view settings or not, the last active display view is saved in the Pythagoras document and restored the next time you open it.

You can define the following options for your view:

1. Select layers that need to be visible in the document
2. Show or hide objects and attributes, such as polygon patterns, texts, point numbers, elevations, comments, special line styles, images
3. Specify certain parameters for visualizing DTMs
4. Activate thematic maps
5. Apply subdocument configurations

A Print View is a combination of a display view that will define the layout of your printout, and the usual print settings. A print view cannot be named or saved and is accessed only when printing a document.

If you do not modify the current display view selections, the drawing will be printed as it is displayed. You can choose another display view or change any of the settings for your print out. Additionally, you specify usual printing parameters like print sheets, number of copies, color conversion, scale factors, etc. (see PART II → Chapter 1: → Print)

Viewports

Complex drawings can become very large and difficult to overview. To help you keep the sight over all the parts of your document, you can create viewports of some parts of the drawing and put them anywhere you need.

A viewport is a small copy of a selected region of the main drawing, which you can adapt to fit your needs. Beside choosing a suitable shape (rectangle or ellipse) and frame to make your drawing look nice, you can adjust other things in the viewport to make it more convenient. You can choose viewport scale, turn it at a different angle, zoom in or out any time.

Generally, a viewport is designed to be an optical enlarging or reducing of the document for all attributes. But to affect this behavior, you can allocate a scaling factor to the viewport, which is not the same as just assigning the viewport a different scale. The scaling factor only affects the size/width of scale independent objects in the viewport. For example if the scale factor of a drawing is 1:500 and the scale factor of a viewport is 1:250, than line width in the viewport will be the double of the line width of the same line in the drawing if scaling factor is 100%. The same for texts: a text of 12 point will become 24 point in the viewport. If the scaling factor is 50%, sizes will remain the same. Any scaling factor is valid, and will affect the scale independent attributes accordingly.

After the viewport is created and set, it is easy to change the size of the frame or move the viewport to another place in the drawing. If you need your viewport at some point to show a different part of the drawing, it is no need to delete it and create a new one: You can “pan” inside the viewport to another location. In addition to all this setting, a view different from the view of the main drawing can be applied to the viewport.

Once you have adjusted the viewport, you can duplicate it or copy directly to another sheet. For instruction on creating a viewport, refer to PART II → Chapter 3: → Create Viewport.

Sheets

Sheets allow you to split up large projects into different print-areas, and thus print the appropriate print sheet along with the appropriate title page, in a very simple manner.

In Pythagoras, you can create multiple (up to 256) sheets per drawing. Sheets refer to the Page coordinate system, thus all objects defined in Page CS will belong to the sheet which was active while they were created. Each sheet can have its own properties such as the printer, dimensions, position, page objects, print area, etc.:

- Printer, paper size and orientation can be set individually for each sheet in the Sheet Manager (see PART II → Chapter 1: → Select Sheet (Print Sheet)). You can also choose a default view for the sheet (different from the current document view), determining the display parameters for layers, subdocuments, object information and so on.

- Sheet position in the drawing, rotation angle and scale are defined with help of Print Area (refer to PART II → Chapter 1: → Select Print Area).

- You can choose an arbitrary polygon as a clipping area for local objects on the sheet: only objects within the clipping polygon will be printed (see PART II → Chapter 2: → Set Print Area).

- For every sheet, you can create an own set of page objects. For this purpose you have to draw any objects (except for coordinate systems, paths and roads) in Page CS. When, for example, choosing the print area for this sheet, you will see that the latter objects are moved together with their sheet within the drawing.

- Legends belong also to the sheet objects (please refer to PART II → Chapter 6: → Legend for details), as well as any logotypes, page framing and other such objects.

- Viewports are defined in page coordinates, so every viewport belongs to a sheet similar to legends. Viewport coordinates are calculated starting from the upper border of the sheet. But viewports never display objects in page coordinates.

Once multiple sheets are created for a drawing, only one at a time can be set as active, which means that this sheet will be printed when you execute the ‘Print’ command. However, to perform, as it were, a 'Print screen' of your drawing (with scale and rotation angle as displayed), you can make the sheet floating. This setting will hide the page, and such a sheet can have no own page objects.

Pythagoras sheets can be exported to AutoCAD by means of saving the document as AutoCAD drawing. Only limitation: AutoCAD has no such notion as Views, so all the sheets will be displayed equally according to the current document view.

Chapter 3: Pythagoras Database

A Pythagoras document can contain an internal database. The main goal of the database is to store additional information about graphic and non-graphic objects. Data can be entered into the database manually or can be imported from other files or databases.

Pythagoras internal database is a traditional relational 2-level (tables, views) database (see definition, for example, here: http://en.wikipedia.org/wiki/Relational_database), but it has some specific features.

Data types and values

Data in the Pythagoras database can be of the following types:

- Integer, stored as 32-bit signed integers
- Real, stored as double precision (64 bits) floating point numbers according to the IEEE standard 754-1985
- Boolean, having only two values: FALSE and TRUE
- Date/time (one type), internally stored as 64-bit unsigned integers expressing numbers of 10 ns ticks starting from the beginning of imaginary Gregorian era (0 hours at January 1st 1 by Gregorian calendar). Leap seconds are not taken into account. Such representation is equivalent to the representation of date/time in both GUIDs (Global Unique Identifiers) and in .NET
- Date, internally stored as number of full days passed since the beginning of imaginary Gregorian era
- Time, internally stored as 64-bit signed integers expressing numbers of 10 ns ticks. This type can be used in two ways: as time of day (number of ticks since midnight) and as a time interval (number of ticks between two moments of time)
- String, any sequences of Unicode characters except prohibited so-called non-characters
- Reference to CAD objects. This means that a database row contains a reference to any CAD object from the same Pythagoras document. Internally, a unique CAD object reference is stored

The above data types comply with following rules:

- Like in other relational databases, a value in a column of each type can be also NULL. But unlike SQL databases, a NULL value and an empty string are treated to be equal.
- Compare operations ‘less’, ‘less or equal’, ‘greater’, ‘greater or equal’, ‘equal’ and ‘not equal’ can be applied to pairs of not NULL values of the same type with only one exception: References to CAD objects can be compared only on equality.

- TRUE is treated to be greater than FALSE.
- Strings are compared in the alphabetical order using operating system means. Therefore, the result of comparing two strings depends on the default language settings. Strings differing only in letter case are always treated as equal.
- Strings are compared completely including invisible characters such as blanks. Therefore, you should avoid string values beginning or ending with blanks.

Note: *Values stored in Pythagoras database do not have any meaning without units. We do not really know what the quantity 2.25 in the column 'Distance' of type real means, until we add 'meters' to it. We strongly recommend that you make notes of the units you use.*

Naming

Tables, views, columns and other database items have names. The name can be any non-empty Unicode string not containing prohibited or control characters. However, you should avoid using extraordinary names because this can cause many problems. For example, tables with too long names or with spaces inside cannot be exported to some formats (e.g., DBF).

In Pythagoras, database names belong to one of four categories:

- Strictly regular names: Names containing only Latin letters from the main set (A–Z, a–z) and digits and beginning with a letter
- Regular names: Names regular in the sense of the SQL standard, but not strictly regular. Such names must contain only letters, signs '$' and '#', and digits, and cannot begin with a digit
- Irregular names, i.e., neither regular nor invalid
- Invalid names: Names containing either control or so-called non-characters. An empty string is also invalid. Such names cannot be used

When you try to use a not strictly regular name, as a rule, you will be warned by Pythagoras. Note that default names in some localization of Pythagoras can be not strictly regular, but they will be always simply regular. Also when two names differ only in the case they are considered equal, e.g., the table name 'Table1' is the same as 'table1'.

Tables

In Pythagoras, database tables can be of two kinds: attribute tables and dictionaries.

Attribute tables

Each row of an attribute table is linked to a CAD object, i.e. the main goal of attribute tables is to store attributes of CAD objects. In other words, an attribute table can be regarded as the class of the linked CAD objects. For example, you can define attribute tables ‘BusStop’ or ‘WaterPipe’ and link objects being bus stops or water pipes to the corresponding tables.

CAD objects of the following types can be linked to attribute tables: lines, points, polygons, texts, arcs, circles, splines, paths, images, clothoids, rich texts, road and compound. For each attribute table, the set of allowed object types can be further reduced. For example, it is logical to restrict table BusStop to points only.

A CAD object cannot be linked to more than one attribute table. Elements of compounds cannot be linked to attribute tables at all. Deleting a CAD object implies automatic deletion of the linked row.

Dictionary tables

Dictionaries are usual relational tables and can be used particularly to define classes of non-graphical objects. For example, you define a dictionary table named ‘WaterPipeKind’. Each row of this table describes one kind of water pipe commodity. While an attribute table ‘WaterPipe’ describes pipes installed (or to be installed) in certain locations, the dictionary table ‘WaterPipeKind’ describes possible kinds of pipes installed or not.

Tables and subdocuments

Tables are stored (both structure and data) in every document. When a document overview is opened tables from all subdocuments are merged and searched for equal names. If two tables with equal names are found, they are checked on equivalence. If at least one such table pair is not equivalent, a subdocument is not opened with a corresponding message.

Tables are considered to be equivalent when

- they belong to the same kind (attribute or dictionary)
- have the same properties
- have the same lists of columns
- their columns have the same names and properties

Additionally, dictionaries must contain the same data in rows to be equivalent. For efficiency reasons, table data are not compared but a new stamp (UUID) is stored after any change in dictionary table data instead. Those data stamps are compared to assure that data are identical. Therefore, dictionary tables will be treated as equivalent only if one is a copy of the other.

An attribute table of an overview contains rows from all opened subdocuments, i.e., number of rows in the table is the sum of numbers of rows in all subdocuments. A dictionary of an overview contains common rows, i.e., the number of rows is the same as in every subdocument.

When a subdocument is stored, its tables are also stored (if they have been changed). But also some other tables can be written to this subdocument, if

it is necessary for the data integrity, for example, if a reference to a table has been made.

You should treat tables used across several subdocuments with special care. Occasional change of structure of such table or of dictionary data can cause problems with opening the overview. To avoid this, we strongly recommend to open all subdocuments together when you plan to perform such actions.

Table columns

Two columns belonging to the same table cannot have equal names. But there is no restriction for columns of different tables and for names used for other database objects.

For each column you define a certain data type. Columns referencing CAD objects can be defined only for attribute tables. In fact, a column of an attribute table can be regarded as an object property. For example, for the table ‘BusStop’ you can define columns ‘RunStart’ and ‘RunEnd’ of type ‘time’ to store arrival time of the first and the last buses.

Other attributes can also be defined for a column:

- minimum and/or maximum allowed values
- whether NULL value is allowed
- types of CAD objects that can be referenced by the column
- etc.

Indexing

A column of each type except references to CAD objects can be declared indexed. That means that an index is built by values of this column. Such an index enables fast search for rows by values in the column. An index does not contain items for NULL values.

Indexing a column does not change any database data or logical run of a Pythagoras session, it only influences the speed of some operations. Beware that when indexing a column you will slow down the following table operations:

- inserting a row with a not-NULL value in the indexed column to the table
- deleting a row with a not-NULL value in the indexed column
- changing a value in the indexed column

Though, indexing a column essentially accelerates searching by values in this column and enables scanning rows in the order defined by values of the indexed column.

You can also declare a ‘unique value’ column. This means that different rows of the table cannot contain equal not-NULL values in this column. To check uniqueness it is necessary to build an index; therefore, a unique value column is always indexed.

References

Often it is necessary to reference one row of a table from another. Continuing our example from above, each installed water pipe belongs to some commodity. Therefore, we can define references from each row of the ‘WaterPipe’ table to a row of the ‘WaterPipeKind’ table.

For example, we define a column ‘Commodity’, type ‘string’, in the ‘WaterPipeKind’ table containing commodity code, and a column with the same name and type in the ‘WaterPipe’ table. The first column has to contain unique values, and therefore, should be declared a unique value column. On the contrary, the second column will contain repeated values.

In this case, the column WaterPipe.Commodity references the column WaterPipeKind.Commodity. The first is called referencing column, the second is called referenced one. Note that such a reference can be defined to another column of the same table, but it is not a typical case.

Column references do not have to be specially defined, but to make the database structure clearer we recommend that you declare them explicitly. The referenced column must belong to a dictionary table and must be a unique value column beforehand.

In case the referenced row is deleted, for the referencing row you can choose one of the following options:

- leave a pending reference
- change referencing value to NULL
- delete the referencing row.

Note: *There are two kinds of references in the Pythagoras database: references to CAD objects and references to other columns. In the case of object references, when the referenced row is deleted the above actions for the referencing row can be defined only via VBA.*

System tables (predefined views)

System tables are special objects of the Pythagoras database that are created automatically and cannot be changed. They are pseudo-tables representing properties of CAD objects. System tables are never stored anywhere.

Each system table corresponds to one or several object types. This means that there is one to one correspondence between CAD objects of these types and rows of the table. Each column of a system table corresponds to some property of objects of these types. For example, all system tables contain integer type column ‘DisplayLevel’: values of display level of objects are written to this column.

Database Views

A Database view displays a subset of the data. In this way you can have a better overview of your data, completely or in parts. Do not confuse the Database (or DB) view with the Display view of the document described above.

DB views do not contain own data, every DB view is derived from other objects. Such objects are called base rowsets or merely bases. A base rowset can be either a table, or a system table, or another DB view.

It can be easier for you to understand the concept of views and bases if you think of them as other kinds of tables. A view just gathers the rows from other database or system tables (or other bases) in one place according to your needs, so that later you can display the data in a convenient format. A base is a table (database or system table) to which conditions are applied and from which the data is gathered. Below you will see some examples of bases and resulting views.

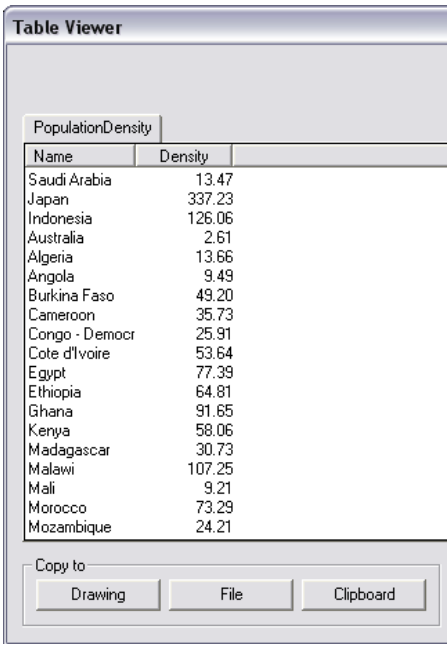
There is a series of expressions defined for every DB view (please refer to Chapter 4: Expressions for definition of expressions). Some expressions define conditions to select or to reject some rows; others are used to calculate values of rows of the defined DB view.

Different DB views cannot have equal names, but their names can be equal to names of tables or system tables. However, we strongly recommend to avoid such coincidences. Rules for column names are the same as for table columns.

A DB view can be either an attribute one or a dictionary, its kind is the same as the kind of the main base. In Pythagoras, only the two simplest kinds of DB views are implemented: a simple view and an aggregation view.

Simple Views

A simple view has only one base, i.e., the view gathers data from one database table (or system table, or another view) applying conditions to it. A complete definition of a simple view consists of a base, a so-called 'where' condition and column definitions. The 'where' condition is an expression applied to columns of the base and having a Boolean value. Each column definition contains a so-called column expression; these expressions are also applied to columns of the base. In other words, the 'where' condition describes, in which rows of the base you are interested in, and the column expression defines what values you want to have in each row.



First, the 'where' condition is applied to each row of the base rowset. Then, for each row returning a TRUE value for the 'where' condition, all column expressions are calculated; they form a new row of the defined view. A column expression often is merely a name of a column of the base rowset.

Example: Given an attribute table 'Countries' linked to polygons and describing countries of the world. The table has columns 'Name' (string) and 'Population' (integer). We want to have an

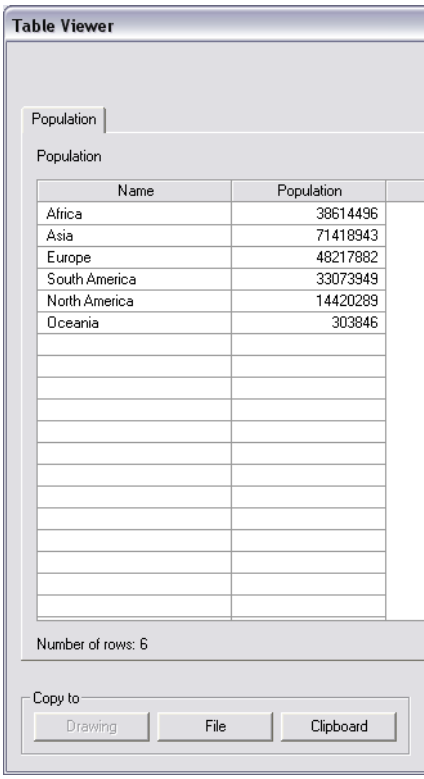
attribute view describing names and population densities of countries with population above 10 million. We define a new simple view based on the table. A 'where' condition is defined as "Population >= 10000000". Column expressions are defined as "Name" and "Population / Area()". 'Area' here is the name of the built-in function returning the area of a polygon
.

Aggregation Views

An aggregation view has two bases: main and auxiliary, i.e., two database tables (or system tables, or views) are involved in gathering the required data. A complete definition of an aggregation view consists of the bases, a so-called 'match' and 'where' conditions, and column definitions.

The 'match' condition is an expression applied to columns of both bases that returns True or False. The 'match' condition is used to choose pairs of rows from both bases.

The 'where' expression and column expressions are applied to both base rowsets but in different manner. It can address columns of the auxiliary rowset only inside so-called aggregate functions. Aggregate functions are functions applied not only to one row but to the whole rowset. Therefore, the expressions of both latter kinds address rows of the main base and address the auxiliary base as a whole, filtered preliminarily by the 'match' expression.



The rest is the same as for simple views. For each row of the main base the 'where' condition is checked. If the value of the condition is TRUE then all column expressions are calculated; they form a new row of the aggregation view.

Example: Continuing our example from above, we are now interested in population of the capitals of each continents. We have two attribute tables: 'Continents' and 'Capitals'. The table 'Capitals' contains information about the population in every city. We want to have an attribute view of the continent names and aggregated population of their capitals.

Therefore, we define a new aggregation view based on tables 'Continents' and 'Capitals'. The 'match' condition is defined as geographical coincidence (a capital is inside the continent polygon). A 'where' condition is defined as "Name not empty", which means that we want to make sure, that we take only existing continent names from the table. Column expressions are defined as "Name" and "Sum(Aux.Population)". 'Sum' here is the name of a built-in aggregate function returning the sum of all values along a rowset.

Spatial aggregation

A spatial aggregation is an aggregation view with both attribute bases and with a 'match' condition expressing some spatial relationship between objects from both bases. The last example above describes a spatial aggregation.

*Example: The 'match' condition can be more sophisticated. For example, to take into account only objects within some distance from one another, we can rewrite the 'match' condition, for example, as "Distance (Main.Object(), Aux.Object()) < N*km()" (distance is not more than N km). In the previous example the 'match' condition can be written as "Distance (Main.Object(), Aux.Object()) = 0". You can also design any expression showing the relationship between main and auxiliary objects.*

Validity and saving

When database structure is changed, tables are checked on their validity, but views are not. This means that when you change the database structure, you will be only warned in some cases that a view became invalid.

Invalidity of a view is typically a consequence of deleting or renaming a database object (table, column, another view), referenced by the view. If you will try to use an invalid view, the requested action will be cancelled and you will see a warning.

Like tables, views are read from and written to documents. But only view definitions are written because view data are built in real time. Unlike tables, views are read from and written only to the main overview document.

Table Viewer

The Table Viewer allows you to view attribute tables, dictionary tables and database views of the active document.

In the table viewer you can hide or unhide columns; change the width of columns and change the sequence of the columns; sort on a particular column in any order. These changes do not have any effect on the table stored in the document, but affect only the representation of the table in your drawing. The changes will be applied when exporting the table.

From the viewer, the table can be:

- Exported to the Clipboard
- Saved as a file in text, RTF or html format
- Put in table form in a Rich Text in the document

Data and structure protection

Data and structure of the database can be protected. There are two kinds of protection:

- protection of both data and structure of one table
- protection of database structure as a whole.

For each table, one of four levels of access can be defined:

1. **Full access (default)** means that both data and structure of the table can be read and changed if there are no other reasons prohibiting this. One of these "other" reasons may be a

subdocument declared read-only, which makes it impossible to change data in rows referring to this subdocument. Also there can be a column that cannot change its data type because it is referenced by another column.

2. **Read/write access** means that table data can be read and written, but table structure cannot be changed.

3. **Read access** means that row data can be read, but neither table structure nor table data can be changed, deleted or added. However, rows of attribute tables can be deleted together with the graphic objects they are linked to.

4. **No access (or VBA access)** means that data can be neither read nor changed and table structure cannot be changed either. However, rows of attribute tables can be deleted together with the graphic objects they are linked to and the table structure remains visible. Data read protection also does not deny the possibility to view table data via database views.

Structure of the database in whole can be protected with the owner name and password. When database structure is protected, no change in structure of tables is possible; particularly table access level cannot be changed. Also view definitions cannot be changed; new tables or views cannot be changed; existing tables and views cannot be deleted.

Chapter 4: Expressions

Expressions are used in Pythagoras to define database views, to express an additional condition in Find dialog, and to define a value to build a thematic map. We introduce a special language to make manual entering of expressions possible where they are necessary.

To facilitate usage of this language, it is designed similar to the built-in language of Microsoft Excel, but it is not completely the same. In Pythagoras, an expression is applied either to a CAD object or to a database row.

A textual expression may contain names of database columns, built-in functions, and different operators. Built-in functions define constants such as π, different mathematical functions, and specific CAD object properties such as elevation.

Expressions can also be built internally when you enter non-textual information. Such are conditions in the database manager, Find dialog, and thematic maps. You fill in a table-like structure - Pythagoras real-time code builds implicitly a corresponding expression.

For further details on expression language please refer to PART IV: Expression Language.

Chapter 5: Thematic Maps

A thematic map is a way to represent graphically object properties or table data, attached to objects, i.e., visually highlight with color and style the objects in your drawing that match the conditions you defined when creating the thematic map.

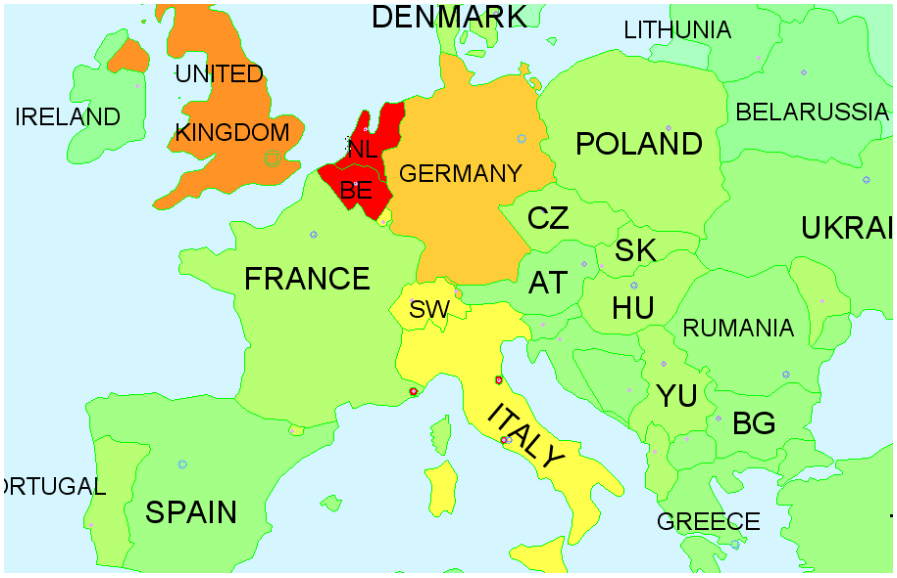
Technically, you choose to which table in the database of the active drawing the required objects should be linked. For all the objects linked to this table or having some requested property, you define a presentation which parameters vary depending on the value of this property.

You can also choose a system table instead of a database table, as every object in Pythagoras is always linked to one or more system tables by default. In this way you will build a thematic map based not on database data, but on some object properties like coordinates, line length, polygon area, layer, etc.

Notice that you can display thematic maps either in local or page coordinates, or in both. All settings for thematic maps are controlled via Thematic Map Manager, see PART II → Chapter 1: → Thematic Maps.

Example thematic map

The definition of thematic maps is better illustrated with an example. Here you can see a part of Europe, colorized according to population density, with symbols of different size indicating capitals and their population:



We can see at first sight that, for example, the Netherlands have the highest population density, and London is the largest populated city.

Note: *When you are building a thematic map for polygons, make sure that they have a property for the pattern (e.g. solid). Otherwise, the thematic map coloring will not work.*

In Pythagoras you can create and activate several thematic maps at the same time, visualizing several conditions at once and determining the order

of appearance on the drawing. The above example uses two thematics at once: Population density coloring polygons (which are countries) and symbols of different size marking capitals (which are points).

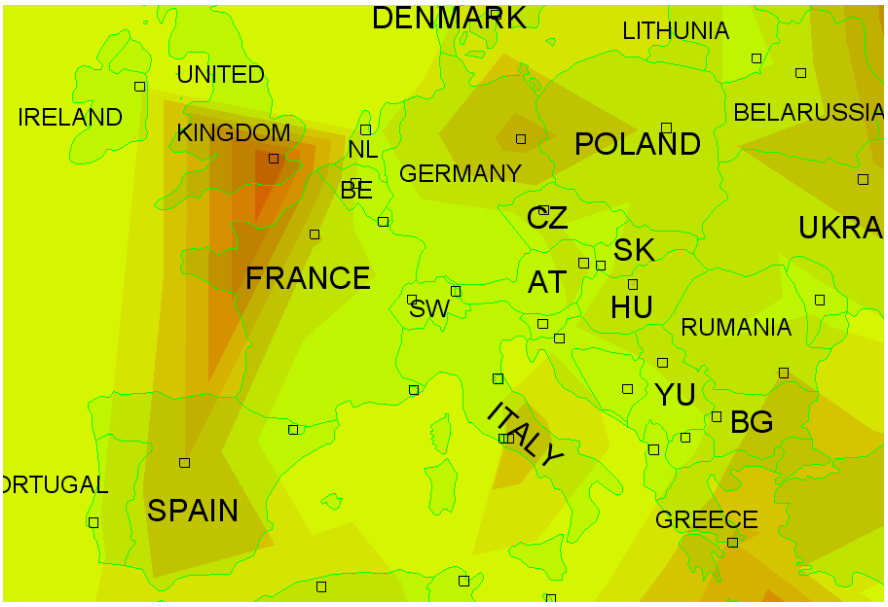
Defining conditions

For the objects linked to the chosen table, you can use either one of the fields of this table as a criterion for building your thematic map, or define an expression using this field. Let us use the above example once again to show how conditions are defined for thematic maps:

- For capitals, we use only points in our drawing linked to the table 'Capitals' which has a column 'Population'. The size of the symbol marking a capital increases according to the value in this column (step is 1.000.000 inhabitants)

- For population density, we use only polygons linked to the table 'Countries' also with a column 'Population'. But in this case we define an expression *"Population / Area()"*, where the value for Population is taken from the column and Area is an object property of the polygon. When the result of this expression falls into a specific range it is colored correspondingly.

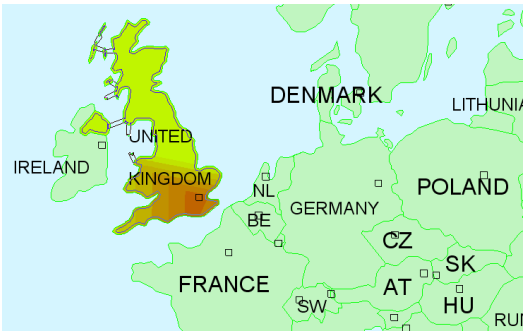
Spatial Interpolation



With help of thematic maps you can manage DTM representation rules, but only if you are building a thematic over database tables linked to points or to points and lines. This setting is called 'Spatial Interpolation'.

Let us build a spatial interpolation thematic map over the capitals of the world. We interpolate between capitals, using population values from the table 'Capitals'. You can compare the resulting thematic map (left) to the previous example without interpolation.

Along with spatial interpolation, you can specify a boundary for your thematic map (only one polygon can be selected as boundary condition). Here, for example, we want to see the interpolation only for Britain:



Chapter 6: Terrain Models

A digital terrain model (DTM) is a digital representation of ground surface topography, or relief. It is also known as a digital elevation model (DEM).

Creating DTM

In Pythagoras, a DTM is represented as a triangular irregular network (TIN). The triangulation is based on a set of points, which are obtained, for example, from land surveying. The network is a Delaunay triangulation (please refer, for example, to http://en.wikipedia.org/wiki/Delaunay_triangulation for background information). Only the selected points and the endpoints of selected lines are included in the calculation.

Note: *It is strongly recommended to work with different layers when you want to calculate terrain models. Hiding the non-relevant layers allows you to select quickly the right objects to calculate the terrain model.*

One Pythagoras drawing can have up to 256 different terrain models, each based on a certain selection of points and/or lines (max. 2 million points or up to 4 million triangles). "Terrain", e.g. can represent the existing terrain, whereas "Design" may represent the design situation (a road, a golf course, etc.)

To reduce the number of points when calculating a DTM, you can cut off the unnecessary points that do not refine the triangulation considerably. For example, points that lie in the plane of an already existing triangle. Also you can remove the boundary triangles that have very small angles and/or large edges and do not add significant accuracy.

When building a DTM, you can select fractures or breaking lines – special lines that define the direction of the relief, e.g., a ravine bottom or a mountain ridge. No lines of triangles will cross a breaking line. The elevation of the endpoints, and the elevation of any point on the breaking lines derived by interpolation, should correspond with the actual elevation of the terrain. Arcs, curves and circles are subdivided by Pythagoras internally in polylines, and each segment of the polyline will be treated as a breaking line.

In case of inconsistencies in data, e.g., breaking lines crossing each other, coinciding points with different elevation, Pythagoras will warn you about the errors and provide a possibility for corrections. You will be able to choose the correct point or line, or edit the drawing, and continue with building the triangulation.

If a polygon is selected, this polygon defines the boundary for the Delaunay triangulation. Any selected point outside this polygon will not be taken into account. This is convenient especially for DTMs with holes or complex borders. If no polygon is selected, Pythagoras will calculate the convex enclosing polygon of the selected points, and the terrain model inside this polygon will be calculated. The height of the vertexes and legs of the polygon should correspond with the height of the terrain. After all, the vertexes are used in the triangulation, and legs of the polygon are considered breaking lines. Clearly, that only one polygon may be selected.

Calculations on DTM

Once you have created one or several DTMs in your drawing, you can perform many useful calculations on them.

First of all, you can combine 2 DTMs which will build a new terrain model based on the difference of the original models within the intersection of their boundaries.

Then, of course, you can visualize your DTMs in several ways:

- Show the triangulation with a selected color
- Show a colorized map of the triangulation based on either elevation or slope of the DTM
- Draw contour lines of the terrain model
- Generate a 3D-view of the active DTM

It is also possible to

- change elevation by adding a value to the z-coordinates of all vertexes;
- calculate a slope intercept connecting points of a polygon to the terrain either using a fixed slope or a fixed distance;
- calculate not only a 2-dimensional area (horizontal area), but also a 3-dimensional area (i.e. the true area, taking account the elevation changes in the terrain).

More complex functions are volume and cross section calculations.

Volume calculation

The volume is calculated within an area defined by a selected polygon. Make sure that the polygon lies ***COMPLETELY*** inside the terrain model. The polygon defining the boundary for the volume calculation may contain points, lines and arcs.

Note: *If the polygon lies partly outside the terrain model, the volume of the non-overlapping part will be estimated based on extrapolation of the DTM.*

The heights of the points forming the polygon do not have any influence on the calculation of the volumes. When two Terrain models are calculated, you may select "DTM1 - DTM2" in the "Earth Moving" dialog box. When selected, Pythagoras will calculate the volume between both models.

The volume calculation is based on numerical integration. The accuracy of the calculation can be improved by making the cross-sections smaller. Of course, calculation time will be greater. The maximum number of cross-sections is 7500.

Note: *The calculation of the triangulation in case that some points are collinear and simultaneously are at the border of the terrain, is sometimes impossible. Pythagoras cannot form triangles at the border. The best solution in this case is to add a few points surrounding the terrain and include them in the terrain model.*

Cross Sections

You have an option to calculate and create profile either along a selected path or perpendicular to it. In both cases you can choose to apply some specific settings. The calculated profile will automatically be pasted in a new drawing and it will be put on the clipboard as well.

Along Path

It is possible to enter the reference elevation, the horizontal X scale and the vertical Z scale for this profile. It will be calculated in the overlapping DTM area only.

The X values in the profile correspond with the accumulated (chainage) distances from the selected path.

You can also add reference objects to the cross-section by selecting them before calling the function to start the calculation.

Perpendicular to Path

In this case you can specify the number of profiles on one row and the distance between the profiles. This distance can be calculated automatically or on a fixed distance. You can also select an existing (prototype) document in which the profiles need to be pasted.

In addition, you can specify chainage and step, and define the layout of the cross section. The first specifies which part of the selected path should be used for the calculation of the sections. The layout of the cross sections can be defined by defining their resp. widths. You have 2 possible choices: either you can use the terrain limits, or you can enter a distance at the left side and at the right side from the path.

The reference level and the horizontal and vertical scale can be defined as well.

Reference objects may be added in the same way as for a cross section Along Path.

Road Design

Roads are designed in connection to the existing relief. Later this relief is used to build the road profile and cross sections. See PART III: Road Design for details.

Operations on DTM

The following operations are possible on a DTM. They are only enabled if the triangulation is visible. For details, please refer to PART II → Chapter 3: → DTM.

- Swap diagonal: replace 2 adjacent triangles by 2 triangles in the same quadrangle using the alternative diagonal
- Delete a triangle
- Delete a point

- Add a point
- Change elevation of a triangle vertex
- Move a triangle vertex

When you modify a DTM, only the terrain model itself is changed, never any point or line that was used as a basis to calculate it.

Note: The operations on DTM are undoable!

Chapter 7: Macros

Macros are programs written in Pythagoras VBA that allow you to extend the functionality of Pythagoras. Here are some examples what you could add to your projects with macros:

- Automation of repetitive tasks
- Integration of processes within a company, e.g. transferring data of a Pythagoras document to a database
- Adding menus and tools to automate tasks that are either specific for a project or provide more general functions

Other possibilities provided in Pythagoras only by VBA are

- Import from and export to non-standard data formats, e.g., SmallWorld, Google KML, PostGIS, GRASS GIS; XML-based formats, like LandXML, CityXML, SVG, GPX, etc.
- Data exchange with Data collector
- Creating diverse reports according to regional standards

Here we provide a short description of Pythagoras VBA environment and managing macros. For detailed information, please refer to the “Pythagoras VBA Manual”.

Pythagoras VBA

Pythagoras VBA is a programming environment that allows you to write your own extensions to Pythagoras. The programming language “Pythagoras VBA” is nearly identical to the language used by the Microsoft products Visual Basic and MS-Office VBA. The way Pythagoras objects (Document, Point, Line, etc) are accessed from VBA is similar to the access of objects in the MS-Office products. Most standard functions of Visual Basic are also available in Pythagoras VBA.

Of course, there are also certain differences. In contrast to Microsoft VBA, the Pythagoras Object Model is not accessible from outside.

The Pythagoras Object Model allows access to nearly all Pythagoras objects such as documents, drawing elements (lines, points, etc.), layers, the selection, to name just a few. This model is very powerful and it allows programmers to extend the functionality of Pythagoras.

Note: In Pythagoras VBA, only standard units for data are used

- *meter for distances*
- *radian for angles*
- *etc.*

If you need to set other units, you can use special functions. Please refer to the VBA manual for details.

Pythagoras Macro Libraries

A macro library consists of one or more modules; each of them consists of one or more macros. Modules are divided into Code and Form (definition of modules would go to far for this manual, please refer to the “Pythagoras VBA Manual”).

Libraries are stored either in the Macro System Libraries file (Pythagoras.mlb) or in a Pythagoras document. So the Pythagoras.mlb file may contain multiple libraries, and each library may contain multiple macros.

When Pythagoras is launched, the Pythagoras.mlb file will be loaded in memory. If a Startup Library is specified, the startup library will be compiled. If the startup library contains a macro with the name OnStartUp, then this macro will be executed. This way, the default environment of Pythagoras can be personalized at startup of Pythagoras.

When a document contains one ore more libraries, these libraries will be read in memory when the document is opened and becomes the top window. Similar as with the system libraries, a document library may contain a Startup Library. This feature allows personalizing the Pythagoras environment when a specific document is opened.

At a given moment only one macro library, either a system- or a document macro library, can be active. This means that only macros of the active (loaded) library can be executed. It is not possible to call macros from other libraries.

Managing macros

The Macro Library Manager provides you control over the available macro libraries: you can rename, delete, move the libraries, etc. You can also assign a startup library or lock a library to prevent changes to the macro code. In addition, you can import and export the system libraries in order to restore and backup the macro libraries.

As you can have several macro libraries (system and document) available for your drawing, you have to load the one you need before starting working with its macro code.

Editing the macro code is done in the Macro-editor. It is a programming environment with its own menu commands that allows you to manage, edit and run the code.

The described functions can be accessed via ‘Macros’ menu, see PART II → Chapter 1: → Macros.

Chapter 8: Defaults

Defaults are basic settings for object graphical attributes that are stored in Pythagoras and applied to any new object.

In Pythagoras, we distinguish also other categories which we also refer to default settings:

- User defaults
- Document defaults
- Preferences

Detailed description of the menu functions you can find in PART II → Chapter 5: The Defaults Menu.

All default settings except for document defaults are stored in PYTHAGOR.DEF file. During the start up of Pythagoras these settings will be initialized.

Graphical attributes

Graphical attributes of objects that you can set to default values are

- Point style and symbol
- Line attributes (style, width, etc.)
- Text attributes (size, style, position)
- Color
- Display level

The changed settings will apply to all newly created objects. They are not stored automatically, you have to choose the 'Save' option, and then your default settings will be invoked the next time you open Pythagoras.

User defaults

A User Default is a named sets of graphical attributes described above, which overwrite the standard defaults when the User Default is selected. You may define up to 256 user defaults. This will allow you to store many different sets of object attributes and have the right set of defaults at hand when you need it, without defining the attributes anew.

For instructions on creating user defaults, please refer to PART II → Chapter 5: → User Defaults Manager.

Document defaults

Document defaults are the settings of the current document. Here you can tune the scale factor of the page coordinate system and bearing of the drawing; set the basic coordinate reference system, and define the next point number for automatic increment. Also the setting for operation confirm belongs to the document defaults.

Document defaults are stored in the current document only. All the new documents are opened with standard settings.

Preferences

The preferences consist of a variety of different settings for such areas as

- Date & Time conventions,
- Units
- Annotations
- Coordinate systems
- Data collector and Geocoding
- Standard texts and comments
- etc.

For the complete list of preferences please refer to the description of ‘Preferences’ dialog in PART II → Chapter 5: → Preferences.

The preferences you have selected apply to all open drawings and to any newly opened drawings. Your selected preferences are automatically saved when you exit Pythagoras, and they are restored when you restart Pythagoras.

Chapter 9: Text Editors

We provide you with the basic text editing tools to help you view, create and handle simple text and VBA programs directly inside Pythagoras. This chapter presents an overview of the available editors.

ASCII editor

Pythagoras default text editor is available in the File menu (see PART II → Chapter 1: → Open Text Files). With this tool you can open simple text files (.txt format), create short texts in Pythagoras, edit text documents.

In addition, Pythagoras uses the ASCII editor to

- Display errors during execution of some actions. For example, when reading CDF or data collector file, the ASCII editor opens to display the line where the error occurred and you can proceed to the next error.
- Open reports after the execution of some commands. For example, after importing or exporting a database table, the log file with the results will be displayed.

The ASCII editor has short toolbar and a simple menu, consisting of basic file, editing and viewing operations. It also supports opening and editing multiple documents simultaneously.

Note: The code page used by the ASCII editor is defined by the current Pythagoras language version.

RTF editor

The Rich Text editor is available in the Tools menu (see PART II → Chapter 3: → New Object: Rich Text). This tool is a lot more powerful than the previous editor; it allows specific formatting and handles .rtf and .doc documents. You cannot open a document directly from the RTF editor: you can either create the text in Pythagoras, or copy/paste it from another program on your computer (for example, Microsoft Word, WordPad, Notepad, etc.).

Whenever you create and paste a table with information into your drawing (for example, Coordinate and Object lists, Table data from the Table Viewer), you can open and edit it using the RTF editor. To add a new row to a table in the RTF editor, put the cursor to the right of the previous table row and press 'Enter'. To delete a row, select it completely and press the delete key. The width and number of columns as well as the column attributes (e.g., background color) cannot be changed in the current version of Pythagoras.

The position of the Rich Text in the drawing can be changed same as of any other object. Also note that the width of the Rich Text in the editor is controlled by the width of the text rectangle in the drawing. The text in the editor is wrapped to the required size automatically.

In the RTF editor you can format your text in any way you like: use any alignment, spacing, text size, color and style. But beware that the text alignment in the editor will define the alignment within the Rich Text rectangle in the drawing, To change the alignment of the block, choose the 'Text Block Attributes' command in the RTF editor, or 'Edit Object' in the drawing.

Note: *Please keep in mind that you set the code page for the RTF editor when you choose a new font for the text you edit.*

Remark: Display of size of the Rich Text (this is also true for normal text) is only correct if the zoom factor is equal to or multiple of 1. So the size of text in a 1/1000 drawing will only be correct on the screen for scales 1/500, 1/250, 1/125, etc. The reason for this is that Pythagoras can display the text on a scale where the font has an Integer size.

VBA editor

You can reach the VBA editor from the File menu (see PART II → Chapter 1: → Macros: Macro-editor). It is very similar to the ASCII editor, but has a different purpose: editing VBA macros. The only differences in the menu from the ASCII editor are the VBA specific commands for compiling and running macros.

Chapter 10: Pythagoras-Toolbar

The Pythagoras-toolbar is a separate set of buttons that represent frequently-used commands.

In addition to standard Windows-document functions (such as opening, saving, printing, etc.), other functions are also present.

Parts of the Toolbar can also be hidden. Please refer to PART II → Chapter 6: → Google Earth

You can view a Pythagoras drawing directly in Google Earth without exporting it first to a KML file. If you select 'View' → 'Google Earth', a KML file will be created in a temporary folder and Google Earth will be opened with this KML file as a parameter.

This menu option is only enabled if conversion to WGS84 coordinates is possible and any exportable objects (not in PageCS) are selected. All features are the same as when you export to Google Earth yourself (see PART II → Chapter 1: → Export: Google Earth).

Toolbars.

You can create and customize your own toolbar, see PART II → Chapter 6: → Customize Toolbars… for instructions.

Selecting Coordinate Reference System

The button invokes the ‘Select Coordinate Reference System’ dialog. There you can select one of the available CRS and assign it a transformation based on tie points sets (if available). Please refer to PART II → Chapter 5: → Set Coordinate Reference System.

Copying Attributes (properties) of a selected object

This button ( ) becomes active when an object has been selected.

When pressing this button, the attributes (properties) of the selected object will be "copied" into a kind of "clipboard" area. This can then be used to apply ("paste") these attributes to other objects. This allows you make use of the properties of objects that have already been drawn, and simply apply them to other objects in the drawing.

Applying Attributes (properties) to selected objects

After copying the attributes of a selected object, they can be "pasted" onto a number of selected objects with the button . This allows you to quickly change the appearance of a drawing.

The 'current settings' can be set in one of 3 ways.
1. Using the menu 'Defaults' and setting each parameter individually.
2. Using ‘User Defaults’ (refer to PART II → Chapter 5: → User Defaults Manager).
3. By copying the properties from existing objects (refer to the previous paragraph).

Measuring the next detail point and Staking out the selected point

The buttons and are only used when the "Tachymeter Module" is activated and a Total Station is connected to your computer.
For more information please consult the Tachymeter Module manual.

Making a Layer Active

The active layer is the layer in which all newly created objects are placed. The name of the active layer is shown in the Toolbar. You can change this layer by selecting the layer name from the pull-down menu.

Making a User Default Active

The User Default that is active determines the properties of the objects that will be created (for a detailed description of User Defaults, please refer to PART II → Chapter 5: : The Defaults Menu).
The name of the active "User Default" that is shown in the Toolbar. You can change the "User Default" by selecting the "User Default" from the pull-down menu.

Macro-buttons (Pythagoras VBA)

Macro buttons ( ) can be assigned to specific VBA programs. The VBA program will be activated by clicking the appropriate button.
The Macro button toolbar will, however, only be made available if Macros have been loaded for which these buttons are applicable (refer to PART II → Chapter 6: The View Menu).

Chapter 11: The Pythagoras Control panel

The Pythagoras control panel is a separate window that is always visible. It shows all information and data that is required while creating points and lines. The information in the control panel is context-sensitive.
For example, when moving the cursor over a line, the length of the line and the distance of the cursor to end points of the line are shown. This function is not only useful to obtain information about objects, but can also be very useful while creating new lines or points.

Pythagoras automatically shows the appropriate entry fields in the control panel. It largely depends on the toolbox item that has been selected and on the object that is currently targeted by the cursor.

When you change the information in an entry field of the Pythagoras control panel (e.g. the distance to one of the end points of the line), all related information will automatically be updated (e.g. the coordinates, the distance to the other end point, the line length, etc.). At the same time, Pythagoras provides instant visual feedback in the drawing window by showing the point or line that is in the process of being drawn.

Selecting the Coordinate System

The selected coordinate system is shown in the control panel. The coordinates shown in the control panel depend on the coordinate system that has been selected.

You can select a coordinate system by selecting the name from the pull-down menu in the control panel.

Selecting Rectangular, Polar or Chainage Coordinates

The control panel shows XYZ, NEZ, HDZ, HVD, HVS or CDZ coordinates. The selection is shown in the control panel. You can change the selection by selecting directly from the pull-down menu in the control panel.

PART II Menu Functions

Chapter 1: The File Menu

New

The 'New' command ('File' → 'New') creates an empty drawing in a new window. The page size will depend on the printer or plotter that is currently selected. If you want to create a drawing for another printer or plotter, you first need to select that printer.

> Microsoft Windows Vista: 'Start' → 'Control Panel' → 'Hardware and Sound' → 'Printers'.

An existing drawing can always be adapted for another printer.

Open

The 'Open' command ('File' → 'Open…') opens a drawing from the disk and displays it on your screen.

When 'Open' is selected the standard "Open" dialog box will appear.
To open a drawing, either select the drawing you want to open and click the "Open" button, or double-click the name of the drawing.
If you need more information on the possibilities of the "Open" dialog box, consult the MS Windows manual.

When a drawing is saved, not only the drawing itself, but also other relevant information is saved with the drawing. The printer for which the drawing was made and the page size are saved with the drawing. This means you can edit a drawing for a printer, which is not selected. Also the "Display options" are saved. The same layers will be visible as at the time the drawing was saved. Be aware, a drawing can contain more information than what is visible on the screen!

When opening a Pythagoras drawing you have the choice to open either a .PYT file or a .PPD file. A .PYT file is a normal Pythagoras drawing; a .PPD file is a Pythagoras Prototype document.

The prototype document can either:

- be copied: the result is a new drawing that is an exact copy of the prototype drawing. The prototype drawing will be closed automatically.
- be opened: the prototype document can be changed and if saved, it will remain a prototype document.

Pythagoras will display an error message when a user tries to open a file that is already opened by another user. That way unwanted parallel operations will be impossible. The file could be opened as "Read-only".

If a file is given the "Read-only"-attribute, Pythagoras will also show you a warning message. In this case you can open the file, despite the fact that the file is read-only. Changes made to the drawing need to be saved using another filename.

Also refer to the -button in the Toolbar

Close

The 'Close' command ('File' → 'Close') closes the window of the active drawing. If the drawing in the window contains unsaved changes, a dialog box requesting confirmation to save appears.

Save

The 'Save' command ('File' → 'Save') saves the active drawing on disk using the filename displayed on top of the window. If it was a new drawing, a dialog box appears requesting the name of the new file.

Also refer to the -button in the Toolbar

Save As

The 'Save As…' command ('File' → 'Save As…') saves a new drawing or a new version of the active drawing.

A dialog box appears, and you type the new name of the drawing. If the name is already used, Pythagoras asks if you want to replace the existing file. The new name of the file will be displayed on top of the active window.

Under "File Type", you can set the file format of your drawing. You can save your drawings in the format of the previous Pythagoras version. E.g.: when you have Pythagoras 12, you can save your drawings in the Pythagoras 11 format. This means that some information – not supported in the previous version - can be lost.

You can also use this "Save As…" function, to save your drawing in DWG or DXF format. It saves the complete drawing, including hidden layers, line widths (as long as no conversion table was loaded), etc. All local objects of a Pythagoras drawing are written in AutoCAD's Model Space. Objects in Paper are stored in AutoCAD's Paper space. Each sheet of the Pythagoras drawing becomes a Layout. Viewports are retained and placed in the corresponding layout.

Further in this manual, we will explain how you can also use the "Export" function to save a file to DWG or DXF format. The "Export" function, however, requires you to first select the objects that you would like to export. This is an important difference with the "Save As…" function.

The saving in the previous version is a one time operation: when selecting "Save" from the "File" menu after you have saved in the previous version format it will be saved again in the format of your active Pythagoras version. We can advise you to save a file in a previous version format after the drawing is fully completed.

The preferences of the chosen printer, paper size and page orientation, which are important for printing data, are part of the drawing and will be saved with the drawing. This means that when opening a Pythagoras

drawing, the printer and page settings for each print sheet will automatically remain the same as when you saved your drawing.

When you save a Pythagoras document with the extension .PPD, that drawing will become a prototype document. A prototype document can be used as a base for a new drawing. On using prototype documents see menu "Open" above.

Drawing Info

The 'Drawing Info' command ('File' → 'Drawing Info…') allows you to edit general information about your drawing. The general information contains the name, the date and the description of the project the drawing belongs to.

Import

The 'Import' command ('File' → 'Import') reads data created with other programs (e.g. data collector information, spreadsheet, other CAD programs) into the active drawing.

The imported data can be either a DXF/DWG file, a SHAPE-file, an SQD-file, a coordinate list, data from a data collector, an image or a list of images. In addition, if the Pythagoras drawing contains a table, information can be imported from a text-file directly into the table.

Note: *Imported text files can be opened directly from within Pythagoras by selecting the menu item "Open Text File".*

IMPORTANT: When importing in a User coordinate system, the elevation of all points in the imported file is considered relative to the elevation of the origin of the UCS.

Coordinate List

A 'Coordinate List' is a text-file containing the point numbers, and the coordinates of multiple points. The structure of a coordinate list file is described in appendix A.

A coordinate list can be made with almost any word processor or with spreadsheet programs. (Microsoft Excel, Lotus 123, etc.).

When you import a coordinate list ('File' → 'Import' → 'Coordinate List'), the coordinates in the file are considered to be in the coordinate system you have selected. When the local coordinate system is selected, the coordinates in the coordinate list are Local coordinates. When a user coordinate system is selected, the coordinates in the file are regarded in the selected user coordinate system. The elevation is relative to the elevation of the origin of the coordinate system. Import in page coordinates isn't possible.

Before importing a coordinate list, you need to set the Pythagoras preferences to the conventions used in the coordinate list. The coordinates in the coordinate list can be Cartesian or polar coordinates and can be x-axis

based (XYZ), north-east based (NEZ), or the coordinates in reference to a path (CDZ).

The z-coordinate is not mandatory. Possible formats are:

a) PntId X Y (Code)
b) PntId X Y Z (Code)
c) PntId X Y Z IH RH (Code)

where IH and RH are Instrument Height and Reflector Height respectively.

Note: *In the control panel WGS84 coordinates are **always** displayed either in DEC (degrees decimal), or DMS (Degrees, minutes, seconds). They are never displayed in GON, RAD or MIL, so if you choose one of these three units in the Preferences, the WGS84 coordinates will be displayed in DEC. If you choose Surveyor, they will be displayed in DMS.*

Comments are imported and linked to the point. In case C, the heights of the instrument and the reflector HAVE to be part of the coordinate list.

If the instrument height and the reflector height are given in the coordinate list, Pythagoras will take these values into account to calculate the elevation of the points.

We do recommend that you use a coordinate list when a lot of points of field data need to be entered.

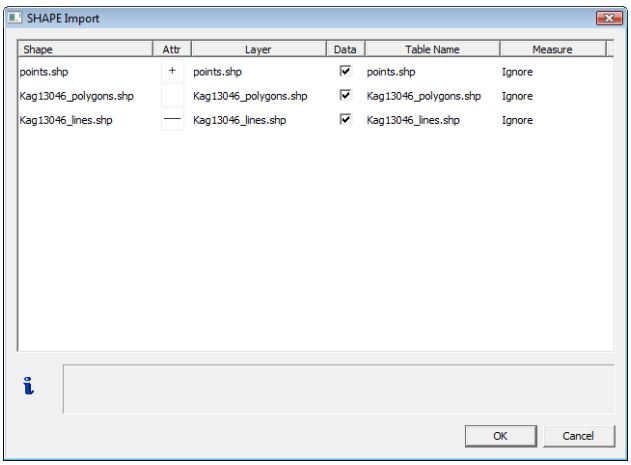
If you would like to import a coordinate list that contains codes, and you would like Pythagoras to take the codes into account (automatic drawing creation), then please use the menu option 'File' → 'Import' → 'Data collector'.

DXF/DWG File

Using this option ('File' → 'Import' → 'DXF / DWG'), you can import the AutoDesk DXF and DWG formats. All AutoCAD versions upto AutoCAD 2010 to are supported.

The scale Pythagoras is asking for is only influencing the size of your texts, symbols, line styles and polygon hatchings. This value will NOT affect the scale of the drawing itself. If you know the scale, you can enter it here and all texts, symbols, etc. will have a correct size. If you don't know the scale, leave it to 1/500 and go to the Sheet Manager (see below) if necessary and adapt the scale of your sheet.

SHAPE-file



Using this menu option ('File' → 'Import' → 'SHAPE'), you can import Shape files created in the ESRI format (*.shp).

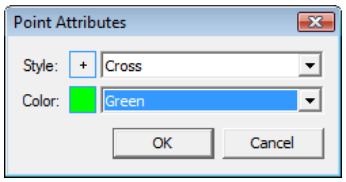
When importing shape (*.shp)-files, data from databases can be imported together with graphical data.

Existing tables are automatically taken over and fields are filled in. A new layer can be created per table and graphical attributes can be defined. It is possible to import the same table twice.

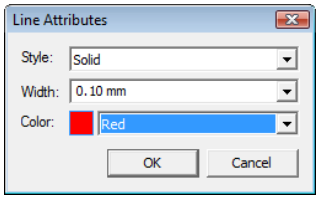
Shape import preferences

- Shape: this is the name of the file that is imported. The defaults for the file can be defined.
- Attr: there are 3 different objects: point, line and polygon. The style of these objects can be changed in this window. Click on the symbol that represents the point, line or polygon. Depending on the object you clicked on, an appropriate window will pop up:

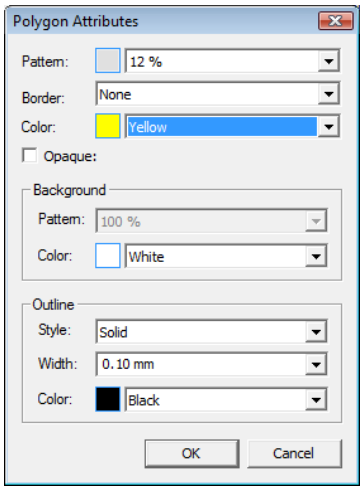
  1. point: color and style can be changed



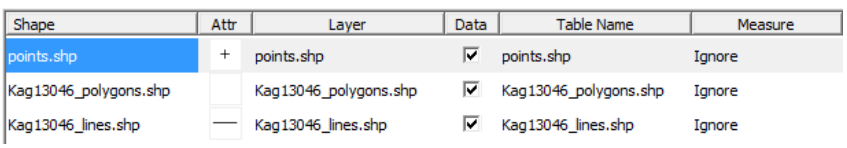
  2. line: color, width and color of the line can be changed



  3. polygon: pattern, color, border and background can be changed



- Layer: here you can choose in which Layer the object should be in. The layer can be created 'on the fly'.



Shape	Attr	Layer	Data	Table Name	Measure
points.shp	+	points.shp	☑	points.shp	Ignore
Kag13046_polygons.shp		Kag13046_polygons.shp	☑	Kag13046_polygons.shp	Ignore
Kag13046_lines.shp	—	Kag13046_lines.shp	☑	Kag13046_lines.shp	Ignore

- Data: to import the data into the drawing.
- Table Name: these names should be unique, they can be changed.
- Measure: ignore (don't change).

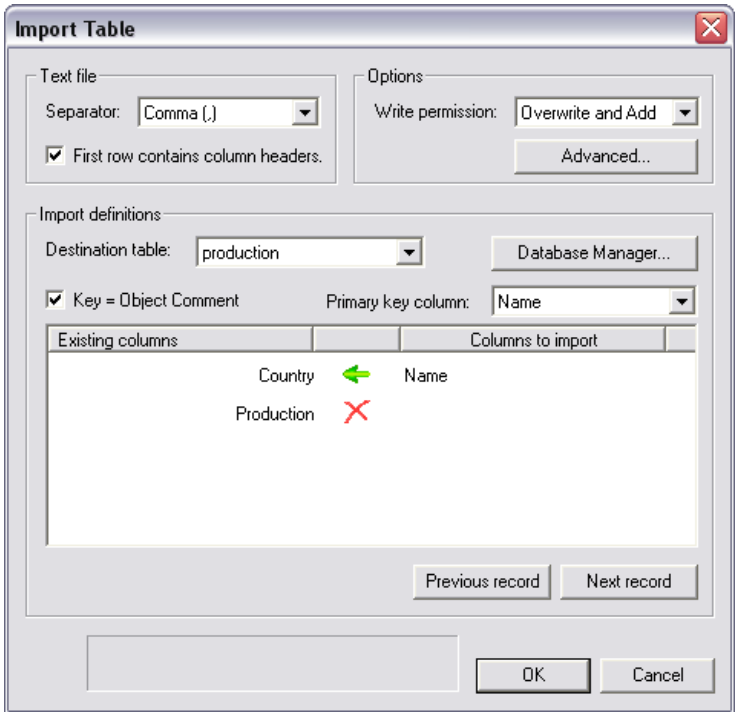
Remark: *The format of the objects can be changed afterwards as well. When importing shape-files, all objects are placed into layers automatically, so it will be easy to select them and change their attributes.*

Table

This option ('File' → 'Import' → 'Table') allows you to import data from a file (in *.dbf, *.txt or *.csv format) into a database table defined in the Pythagoras drawing.

It is important that the document into which you want to import data already contains database tables. Otherwise, you will be warned by Pythagoras and the import will be aborted.

As a first step, you will be prompted to choose the file that you want to import. Then, the following dialog will appear:



- Text file: Here you select the type of column separator in the data file. You have a choice between Tab, Comma (,), and Semicolon (;). If the selected separator is wrong, the data will be read-in incorrectly. Also you can indicate whether the first line of the file should be imported or ignored as column headers.

- Options: The imported data might contain information already present in the destination table. You can choose to update the table and add new rows (Overwrite and Add), only overwrite existing data, or only add new rows. The 'Advanced' button will lead you to the settings for text encoding, decimal sign and date format.

- Import definitions: After you select the destination table, you can edit its settings and add or remove columns by pressing the 'Database Manager' button. A new table cannot be created during import, you should take care of it in advance.

  Note: The destination table can be either an attribute table or a dictionary; import into a system table is not possible.

Definition of a key column is a vital part of successful import. You have to indicate columns for data comparison both in source and destination tables. The column of the source file can be selected from the ‘Primary key column’ list. The column of the destination table can be either correspondent to the source column, or the Object Comment if you are importing into an attribute table (check the option ‘Key = Object Comment’).

During import, Pythagoras will search for matching keys and update the database table according to the selected write permission. In case of an attribute table with the primary key not the object comment, the key must be unique and no rows can be added to the table – write permission will be only overwrite.

- In the main list you can see the columns of the database table (left). On the right side you can choose column names to be imported into each database column, For selected pairs, the the middle column will show a green arrow . If a column will not be imported, the middle column will show a red cross .

  You can use the buttons ‘Previous record’ and ‘Next record’ below the column list to scroll through the first 10 entries of the imported file. This way you can check that the separator is selected correctly and make sure that you are importing the correct data.

After you press the ‘OK’ button, the import will proceed and Pythagoras will show you a log file with results.

SICAD-SQD

With this option ('File' → 'Import' → 'SICAD-SQD') you will import the SQD files of the SICAD software.

Data Collector

The 'Import Data collector' command ('File' → 'Import' → 'Data Collector') allows you to read files retrieved from data collectors and total stations. Therefore, these files have a format that is defined by the manufacturer of the instrument.

You have the possibility to adjust the traverse measurement during import of the field data (if points are measured that can be adjusted). This is only possible when you obtain the module “Geocoding”. For more information see the "Pythagoras Coding Manual" manual.

If Pythagoras detects errors while importing data from a data collector, it will open the data collector file in the Pythagoras ASCII-editor and will highlight the line that contains the error. After correcting the error(s), you can make Pythagoras re-read the data collector file by pressing the F1 key. The corrections will be saved and re-read all at once.

If you would like to import a coordinate list that contains field codes, please make sure to first select "coordinate list format" as the data collector format in the Preferences dialog box (see PART II → Chapter 5: → Preferences).

Image

Using this command ('File' → 'Import' → 'Image'), Pythagoras will read an image (or multiple images if multiple files are selected in the "Open" menu) into a Pythagoras drawing.
Pythagoras can automatically georefence an image if the file is either a GeoTIFF file or if a World File (e.g. TFW-file) is present in the same folder as the image file.

Images can be imported in 2 ways:
1. Image per image
2. With a list of images

Image per image
During import you get the choice whether you want to geo-reference the images or not. If you choose the automatic referencing, the image will be positioned on the right coordinates. If you choose not, it will be placed in the middle of your page.

With a list
You also can choose to import images with a list. This list contains file names of the images to import with their respective coordinates.
It is possible to enter images of different formats in this list. If there are GeoTIFF images or World Files (e.g. TFW-files), Pythagoras will ignore the coordinates that are entered in the list (if any). The coordinates given in the format itself or in a World File have priority on the ones entered in the list.

List of Images

It is possible to import a series of images in Pythagoras ('File' → 'Import' → 'List of Images'). This is done by creating a text-file containing a list of images that need to be imported.
It is also possible to give the images certain attributes (layer, scale, etc.)

This means that the import of multiple images (e.g. maps used as background, which cover entire country areas) is fully automated.

Syntax of the text file

The structure of such a text-file is described below:

The file contains two parts:
1. The header
2. A list of filenames of the maps with coordinates of their ***bottom-left corner*** and possibly their upper right corner. This last one is used if the image has been deformed during scanning. By entering coordinates of the upper right corner, the image will deform in a way that it will fit in the square given by the coordinates.

The header

Note: a TAB or a space separates each field

1. The header always starts with a colon.
2. **Original images**: full pathname of the original image files (TIFF or BMP) is entered here

3. **Pythagoras image files**: Pythagoras converts the original images to its own format. Here, enter the full path name of where they need to be saved after conversion

Note:
   1) *Windows separates the maps/directories with backslashes, e.g.: "C:\documents\images\".*
   2) *Keep in mind that the paths need to end with a backslash.*
   3) *In case there are spaces in the path names, the path needs to be entered between double or single quotes (" or ').*

4. **Scale**: the scale of the original images
5. **Display level**: We advise to use the lowest display level (=-10), because images are often used as a background. In this way drawn objects will not be hidden by the image
6. **Layer**: If the layer does not yet exist, it will be created automatically
7. **Color**: the color is specified by a number (0=black).
8. **"Y" or "N"** (only used for B&W images)
   Y → invert picture
   N → no inversion
9. **Brightness**: entered in "%" (100%, 75%, 50%, …)

The list

The list looks like:

"Filename" "X-coordinateLUn" "Y-coordinateLUn"
"X-coordinateRUp" "Y-coordinateRUp"

Remark: the filenames could have extensions. Check their names from the list with the originals.

Example

Here is an example of such an import file:

```
:"C:\DATA\"   "D:\GIS\NGI\"  1/10000 -1 NGI10000  0  N  100

top08-2.tif     170018.075      228172.645
top08-3.tif     178019.075      228172.645
top08-4.tif     186019.440      228172.645
top08-6.tif     170017.440      218172.030
top08-7.tif     178017.805      218172.030
top08-8.tif     186018.805      218172.030
top16-4.tif     186017.535      208171.415
top16-8.tif     186016.900      198171.435
top17-1.tif     194017.900      208171.415
top17-5.tif     194016.630      198171.435
```

Export

The 'Export' command ('File' → 'Export') writes information of selected objects to a file in one of the following formats:

- Coordinate list (or offset list in case you're exporting CDZ)
- DXF/DWG file
- Terrain model
- Image

- Shape
- Table
- SICAD-SQD file
- Object list
- Stake out list

A selection should be made before exporting data. When exporting data, all coordinates written to the export file are relative to the coordinate system, which is selected at that moment. Also the conventions used (see PART I → Chapter 1: Coordinate Systems), are those selected when you export data.

Note: Exported text-files can be opened directly from within Pythagoras by selecting the menu item 'File' → 'Open text file' → 'Open…'.

Coordinate List

The coordinate list contains only information about the selected points. The information contains:
1. the point number
2. the coordinates (XYZ, NEZ or HDZ).
3. Optional comment (e.g. a field code)

Attributes and other information are not exported.
Point number always sorts a coordinate list exported by Pythagoras.

Pythagoras has an option ('File' → 'Export' → 'Coordinate list') to include the points without point numbers.

You can directly view the Coordinate List by selecting menu 'File' → 'Open text files' → 'Open'.

The coordinate list file can have one of the following formats:
- RTF-file (*.rtf)
- Webpage (*.html)
- Comma separated text file (*.csv)
- Semicolon separated text file (*.txt)
- Tab separated text file (*.txt)

You can read the Coordinate list in most word processing and in spreadsheet programs. This allows you either to format and print the coordinate list according to your wishes, or to do calculations with the exported data.

Note: If you export CDZ coordinates (relative to a path), the coordinates relative to the path will be exported.

DXF/DWG (AutoDesk exchange format/AutoCAD Drawing-format)

The selected objects will be exported to a DXF- or a DWG-file ('File' → 'Export' → 'DXF / DWG'). DWG is AutoCAD's standard format. DXF-files, on the other hand, can be imported into AutoCAD as well as into most other CAD programs. All objects will be exported in 3D. All AutoCAD versions up to AutoCAD 2010 are supported.

Pythagoras supports all the versions starting from AutoCAD Rel.13 as well as the respective LT-versions.

Conversion to DXF/DWG can be customized to meet the requirements of the user for the DXF/DWG file.

1) Points
   - As point (AutoCAD POINT): Each selected point will be exported as a POINT, independently of the style. The style of the point (symbol), as it is in the Pythagoras drawing, is lost.
   - As symbol: A BLOCK will be placed in the DXF/DWG file for each Pythagoras point style. The points in the DXF/DWG file will be exported as INSERT <BLOCKNAME>.

   Exporting the point as a symbol has the additional advantage that the point number and the point information are exported as ATTRIBS. An AutoCAD-user can thus search this information or make it visible on the drawing.

2) Symbols
   Symbols can be exported to the DXF/DWG file in 3 different ways:
   - as point: this method is recommended if the recipient of the DXF/DWG file has no need for the symbol as it is used in the Pythagoras drawing.
   - as symbol: A BLOCK will be in the DXF/DWG Blocks Section for each symbol that is used in the drawing. The symbol itself will be created in the DXF/DWG file by an INSERT (Block name, X scale factor, Y scale factor, rotation angle).
   - unpacked: the symbol will be unpacked into its basis elements and exported in the ENTITIES section of the DXF/DWG file.

3) Lines
   Older versions of the DXF/DWG format do not have a notion of line thickness. Using a text-table, you can specify how the thickness (width) of a line in the Pythagoras drawing is converted into a certain color in DXF/DWG file. Loading this table can be done by specifying a Color to Width file in the Preferences dialog box (more about this in another section of the manual).

   The Pythagoras "standard" line styles as well as any "custom" line styles that can be converted to LTYPEs, will remain. The following section thus only applies to other "special" line styles.

   Special line styles can be exported to the DXF/DWG file in one of the following ways:
   - as a normal (solid) line: this method is recommended if the user of the drawing has no need for the line style that is used in the Pythagoras drawing.
   - line style is retained: A BLOCK will be exported in the DXF/DWG Blocks Section for every line style that is used in the drawing. The BLOCK contains the drawing of one segment. The line itself is created in the DXF/DWG file using an INSERT (Block name, X scale factor, rotation angle, column count).
     Arcs and circles are exported as one "anonymous" BLOCK.
   - unpacked: the lines will be unpacked (split up) into its basis elements and exported into ENTITIES section of the DXF/DWG file.

4) Export of invisible points
   Invisible points are only exported (as DXF/DWG POINT), if "export invisible points" is checked in the dialog window.

5) BLOCK-names
   The names of symbols and line types in the BLOCKS Section of the DXF/DWG file match the names used in the Pythagoras drawing. Either the combination of the names "group" and "symbol" separated by "_" is used, or the name of the symbol without group name is used.

Note:

- *Patterns: These are exported as an AutoCAD 'HATCH'-entity. Only polygons that cannot be converted into a HATCH-command are exported as an "ANONYMOUS BLOCK".*
- *If you would like to export the complete drawing (including information that is located in page-coordinates), the whole drawing needs to be in Local coordinates (you will thus first need to move anything that is in Page coordinates, into Local coordinates).*
- *In order to avoid a rotation of the drawing in another CAD program, make sure to select a horizontal coordinate system before exporting.*

6) Export polygons/paths as polyline
   If you select this option, all selected polygons and paths will be exported as an AutoCAD-POLYLINE.

Note:

- *When exporting selected objects, only those objects are exported. When saving a document in AutoCAD format (see Save As), the complete document including Paper objects, Sheets and Viewports is exported.*
- *We already mentioned that AutoCAD has no such notion as Display Views. Please beware, that all sheets exported in DXF/DWG format will be displayed equally according to the current document view.*

Terrain Model

The active terrain model is exported in DXF/DWG format ('File' → 'Export' → 'Terrain Model'). Every triangle becomes a 3DFACE entity in the DXF file. These files can be read by some 3D drawing programs and rendering programs, and eventually render a photo realistic image of the terrain.

Image

A selected image can be saved as a BMP or JPG file ('File' → 'Export' → 'Image'). The dialog window that pops up allows you to specify a file name and location.

SHAPE

The selected objects will be saved into a SHAPE-file ('File' → 'Export' → 'SHAPE'). SHAPE is the format in which ESRI-drawings are saved. They are also used in programs such as ArcInfo, ArcView, etc. All objects can be exported in 3D.

The conversion to SHAPE can be specified to meet the needs of the user of the SHAPE file.

You should be careful when exporting documents with tables into a SHAPE-file. Similar to Pythagoras database (see PART I → Chapter 3: → Naming), ESRI-drawings also have rules for table and field names:

- Length of field names is limited to 10 characters. However, there is no limit on table names.

- Table and field names cannot start with an underscore or a number. Field names must begin with a letter.
- The following characters are not supported: spaces, hyphens such as 'x-coord', brackets, and other special characters.

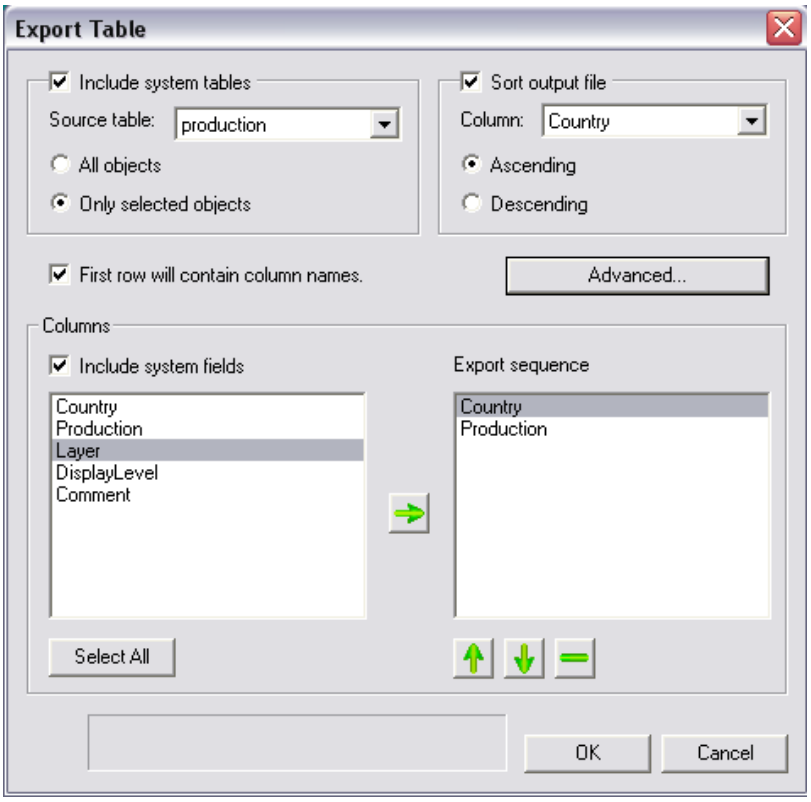
Table

The database attributes or even the graphical attributes (from the so called system tables) of selected objects will be exported in a *.dbf file or in a *. text-file ('File' → 'Export' → 'Table').

As a first step, you will be prompted to give the file name and format to export to. You can choose between a DBF file and a text file with a certain separator type:

- Comma-separated (*.csv)
- Semicolon-separated (*.txt)
- TAB-separated (*.txt)

Then, the export dialog will appear:



- Source table: You can export not only the attribute tables that you created (or imported) yourself, but also Pythagoras system tables containing object attributes. However, dictionary tables cannot be exported. If you check the ‘Include system tables’ option, the names of the system tables will appear in the ‘Source table’ list after the database tables.

  Also you can choose to export attributes for all objects in your drawing or only for selected once. If no objects are currently selected, Pythagoras will give you a warning and switch off this option. If you have selected some objects in advance, checking the ‘Only selected objects’ option will filter the source table list and leave only those tables, that refer to the selected objects.

- Sorting: The output file can be sorted either in ascending or in descending order by the column that you choose from the list.

  Also you can insert the column headers into the output file by checking the option ‘First row will contain column names’. Though this option is only enabled, if you are exporting a text file.

  Some additional settings for text encoding, decimal sign, and date and time format can be made in a separate dialog by pressing the button ‘Advanced’.

- Column lists: The list on the left contains all columns of the selected table. If you are exporting an attribute table, you can add columns of system tables such as Comment, Layer, etc., by checking the option ‘Include system fields’.

  The columns selected in the left list will be transferred to the right side when you press the green arrow Then you can edit the list of exported columns with the buttons under it and change the column sequence or delete the unnecessary once.

Pres the ‘Ok’ button after you are finished with the export settings, and Pythagoras will proceed with exporting the table and will show you a log file with results.

Google Earth

Pythagoras drawings can now be exported to Google Earth. Similar to export in other file formats, when you choose 'File' → 'Export' → 'Google Earth', Pythagoras will request a file name and save in in the KML format. This menu option is only enabled if conversion to WGS84 coordinates is possible and any exportable objects (not in PageCS) are selected.

Only Lines, Polylines, Arcs, Circles and Polygons are exported. The height of these objects is not taken into account; they are put on earth’s surface. After exporting to Google Earth you will be able to:

- Get a view of a project on top of aerial images without the need to have those images;
- Distribute the resulting KML files.

Specific features of the Google Earth format export include:

- Only selected objects are exported.
- The active thematic map is applied to attributes written to the KML file.
- Pythagoras layers are written to Google Earth folders.
- Objects are displayed in Google Earth taking into account the display levels in the Pythagoras drawing.
- Only the polygon patterns are exported: 12.5%, 25%, 50%, 75% and 100% (solid). The opacity of a polygon in Google Earth will depend on the percentage: 100% will become completely opaque and 12.5% will have the smallest opacity (that is, highest transparency).

You can also directly view a drawing in Google Earth by selecting the corresponding option in the View menu, see PART II → Chapter 6: → Google Earth.

SICAD-SQD

The selected objects will be saved as a SQD-file ('File' → 'Export' → 'SICAD SQD'). This is the format of the SICAD software.

Object List

An exported object list is a text-file containing for each selected object the respective info. For polygons, for example, it can contain the area of the polygon, optionally, the point numbers of the points forming the polygon, and the perimeter (horizontal and slope) of the polygon. For points you will obtain their point numbers and their respective coordinates, etc. ('File' → 'Export' → 'Object List').

The object list file can have one of the following formats:

- RTF-file (*.rtf)
- Webpage (*.html)
- Comma separated text file (*.csv)
- Semicolon separated text file (*.txt)
- Tab separated text file (*.txt)

Stake-out List

The selected objects will be exported ('File' → 'Export' → 'Stake out List') to the format of the selected measuring device. The configuration of the measuring device is done in 'Defaults' → 'Configure' → 'Data Collector…'.

Open Text Files

Pythagoras saves the names of the 9 last imported and exported text files. These names will appear in the menu 'Open Text File' ('File' → 'Open text files'). Select the file you would like to open.

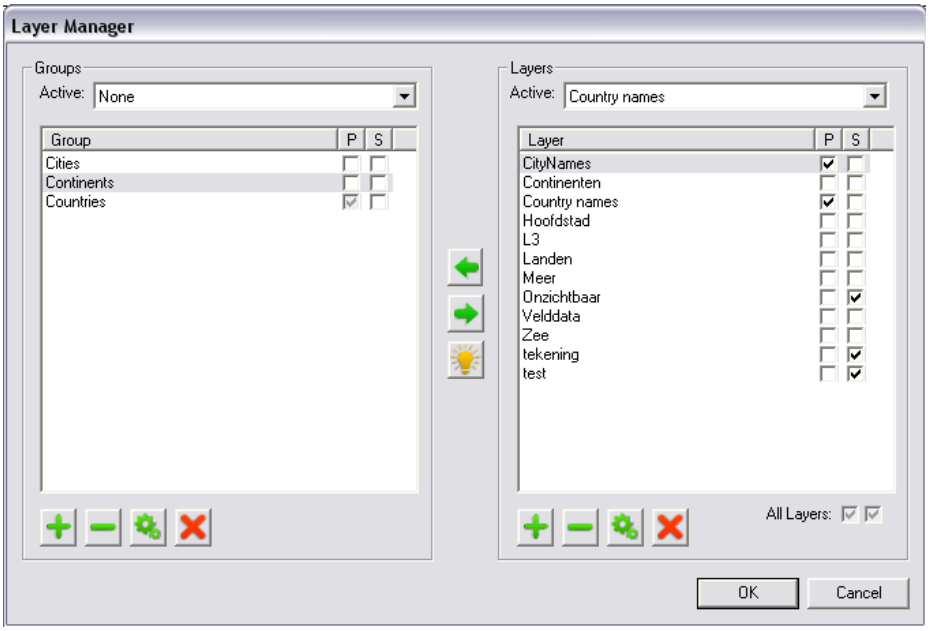
These text files are opened in the Pythagoras ASCII-editor. You can also open a file directly using 'Open' or create a new text document using 'New'.

If the text-file is too large for the Pythagoras-editor, an alternate text editor will be used.

Selecting a text editor:
Windows will use the default application for ".txt"-files

Layers

With this command ('File' → 'Layers…') you control the use of layers.



Groups:

You can create logical layer groups to simplify your layer management: e.g. topography, gas, water, electricity, etc. Layers can be added to a group or removed from it one by one or several at once.

Attributes:

You can add the attributes "**P**rotected" and "**S**witch off" to layers and to groups. The layer visibility is set in the Display View dialog, see PART II → Chapter 6: → Display View.

If the "P" attribute is set, the layer will be protected. This means that all modifications to such a layer will be denied by the program.

The third attribute "S" shows the objects of the layers resp. groups in a passive way. This means that the objects will be shown, but they cannot be modified, or selected.

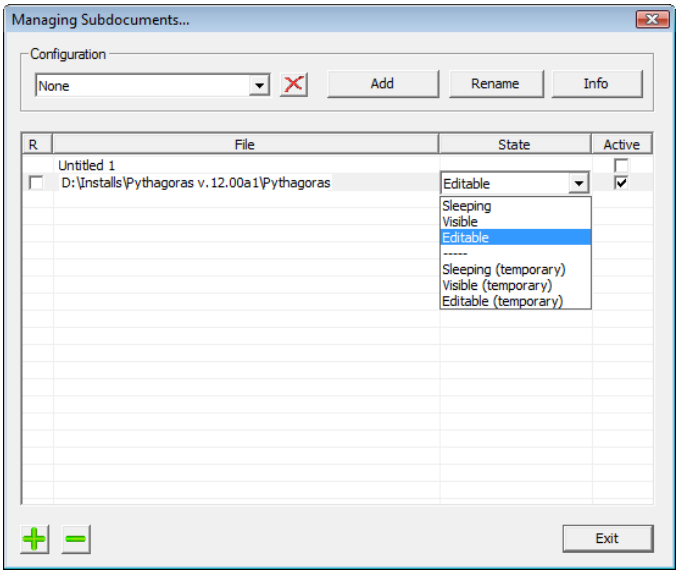
Using the option "All Layers" allows you to set options for all layers, using one mouse click.

Scale dependent view:

To make a layer visible only between certain scale factors, press 'Layer Set Up' button and a new dialog box will appear. Here you can enter the upper and bottom scale factors.

Remark: A scale limit needs to be entered as a 1/n figure, with n as scale number. If you don't want to enter an upper limit or a bottom limit, you leave the regarding fields "From" or "To" blank.

Subdocument Manager



The Subdocument Manager ('File' → 'Subdocument Manager…') gives you the possibility to view and control the documents you linked together. Here you can add, remove, and change settings for each Subdocument.

The icons "Add" and "Remove" serve to add and remove documents.

Different settings are possible for each drawing. You can set each document into one of the following states:

- "Sleeping" or "Invisible" (not loaded into memory, in order to maintain processing speed).
- "Visible" (visible, but not editable).
- "Editable".
- All these states could be chosen as temporary – they are not saved with the document.

Note: *Temporary means that the state (Sleeping, Visible, Editable) is not part of the Configuration. When switching to this configuration, the "temporary" states will inherit the state of the previous configuration.*

Any objects that are newly created will be placed in the document that is marked 'Active' at the time the objects are created.

If "R" → "Relative" checkbox is checked, common part of the paths will not be shown.

Configuration that you created could be saved. The upper part of the dialog presents the Configuration control buttons:

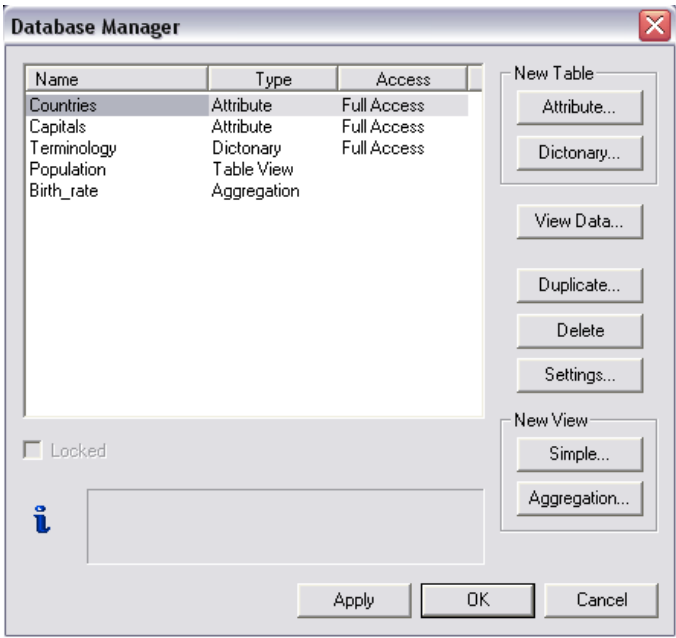
- Add a new configuration by entering a name in the pop-up dialog
- Delete current configuration (press button)
- Rename an existing configuration
- Show information on the Views in which the current configuration is active by pressing the 'Info' button

Database

Each Pythagoras drawing can contain an internal database, consisting of one or more tables.

Database manager

The database manager ('File' → 'Database' → 'Database Manager') allows you to define the structure of the database:



- create tables (‘Attribute…’ and ‘Dictionary…’)
- create DB views (‘Simple…’ and ‘Aggregation…’)
- duplicate, rename, and delete existing tables and views
- edit table structure and view conditions (‘Settings...’)
- view data of tables and DB views (‘View Data…’)

You can also lock your database structure with a password to prevent changes by other users. The checkbox ‘Locked’ is enabled only if all the recent changes are confirmed and saved (either by pressing the ‘Apply’ button or by pressing OK).

Table Structure

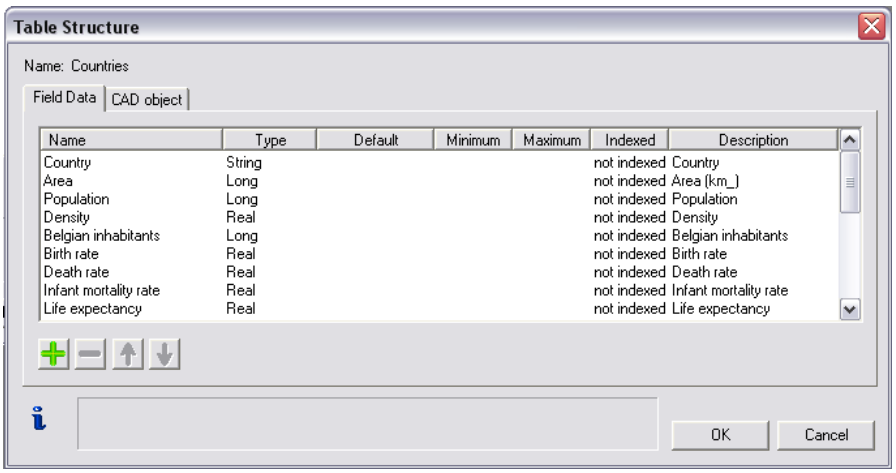
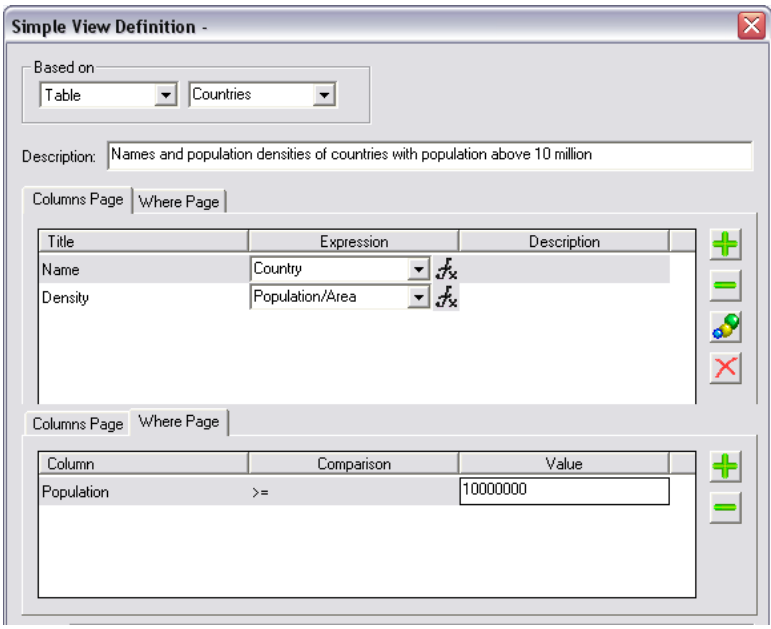


Table Structure
Name: Countries
Field Data
CAD object
Name Type Default Minimum Maximum Indexed Description
Country String not indexed Country
Area Long not indexed Area (km_)
Population Long not indexed Population
Density Real not indexed Density
Belgian inhabitants Long not indexed Belgian inhabitants
Birth rate Real not indexed Birth rate
Death rate Real not indexed Death rate
Infant mortality rate Real not indexed Infant mortality rate
Life expectancy Real not indexed Life expectancy
OK
Cancel

In the ‘Table Structure’ dialog you can change column names, types, default and limit values, and define indexing. All the above actions you can perform in the ‘Field Data’ tab simply by clicking into the column. Buttons for adding, removing and changing column sequence are below the list.

For attribute tables only, there is also a second tab ‘CAD object’; there you can specify the type of objects that the table can be linked to.

Simple Views



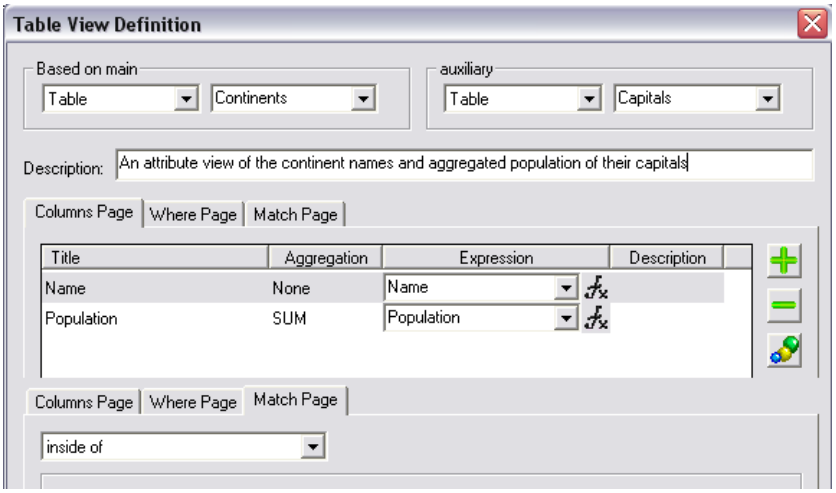
The simple view dialog consists of the base definition and two tabs for column and ‘where’ conditions. Building of simple views is described in detail in PART I → Chapter 3: → Database Views.

The same example – a simple view describing names and population densities of countries with population above 10 million – is presented in the dialog.

Aggregation Views

The aggregation view dialog consists of the main and auxiliary bases definitions and three tabs: For column, ‘where’, and ‘match’ conditions. Building of aggregation views is described in detail in PART I → Chapter 3: → Database Views. The same example – an aggregation view describing

names and population of the six continents – is presented in the dialog; here you can see the column and the ‘match’ conditions:



<u>Remark</u>: There are three kinds of ‘match’ conditions for your choice:

- *‘inside of’ – valid only for points inside a polygon*
- *‘within distance of’ – compares the distance between any objects*
- *expression – allows to enter any valid expression*

Table Viewer

This dialog can be accessed either from the Database Manager (press ‘View Data’ after selecting a table in the list), or directly from the menu ('File' → 'Database' → 'Table Viewer’). The Table Viewer makes it possible for you too see the contents of existing tables and DB views at a glance.

Mail Merge

This function ('File' → 'Database' → 'Mail Merge…') allows you to send form letters automatically. Certain information in these form letters can be filled-out automatically from the data in the database or based on graphic attributes of selected objects.

The form letter needs to be created as a Pythagoras document that contains a text object with text and placeholders. A placeholder always starts with <* and ends with *>. This means that these character sequences may not be used in the letter for other purposes. A graphic attribute is indicated with a ‘# ‘sign. The names of tables and fields are **not** case sensitive. Valid placeholders include:

<*table.column*> for database columns
<*#object type.attribute*> for graphic attributes

<u>Example:</u> Imagine the following text of a New Year greetings card:

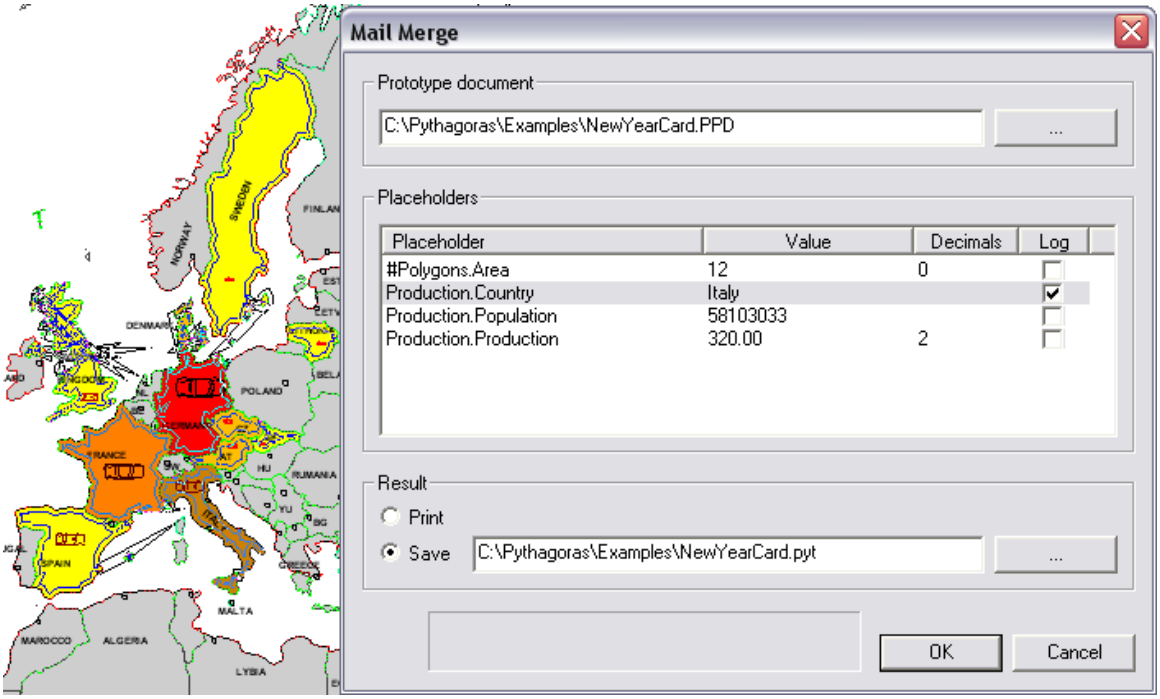
*Dear colleagues from **<*Production.Country*>**,*

*in the current year **<*Production.Production*>** of new diesel cars were produced in your country. Taking into account that the area of your country is **<*#Polygons.Area*>** thousand sq. km, and the population is **<*Production.Population*>**, the number of produced cars should increase next year.*

Happy New Year!
Management

We assume that the database table ‘Production’ with above columns exists in the Pythagoras drawing and the mail merge is performed on polygons.

First of all, we select the polygons representing countries that we want to write to. Then, we call the function 'File' → 'Database' → 'Mail Merge…' and we are prompted to open the prototype document (which can be either a Pythagoras document or a text file). Following, the Mail Merge dialog will appear:



In the upper part the prototype document with the letter text is given, the lower part shows the output. You can choose whether the resulting letters should be printed out immediately, or saved in the selected format. For saved documents, incrementing numbers will be added to the names.

The ‘Placeholders’ part shows the list of all the placeholders found in the form letter. For your convenience, the ‘Value’ column shows the values of the first selected object that will substitute the placeholders. If a value is of type Real, you can choose how many decimal numbers will be shown in the letter in the ‘Decimals’ column. In the last column ‘Log’ you can indicate the value that will be used for the log file.

Note:

- *The prototype document is analyzed immediately after you give the path to it. If the syntax is wrong or if a placeholder is invalid, you will see an error in the ‘Value’ column, e.g., "Unknown field", "Unknown Table", "Error in expression", etc. When there is an error, mail merge will not start.*
- *All placeholders must refer to the same table. If any selected object does not refer to the given table, a warning will be given. The warning will contain the number of records not referring to the table. It is up to the user to continue with the mail merge or not.*

Remark: Placeholders can be more sophisticated than just a table and a column name. You can use database expressions described in PART I, for example:

*<*Cities[Name=Countries.Capital].Population*>*

where 'Cities' and 'Countries' are two attribute tables in a Pythagoras drawing. The merging is done with the table Countries. This means that all selected countries are evaluated a row at a time. According to the placeholder, the field 'Population' of the table 'Cities' has to be displayed. The row is defined by the column 'Name' in 'Cities,' where the value for 'Name' is determined as 'Countries.Capital'.

Thematic Maps

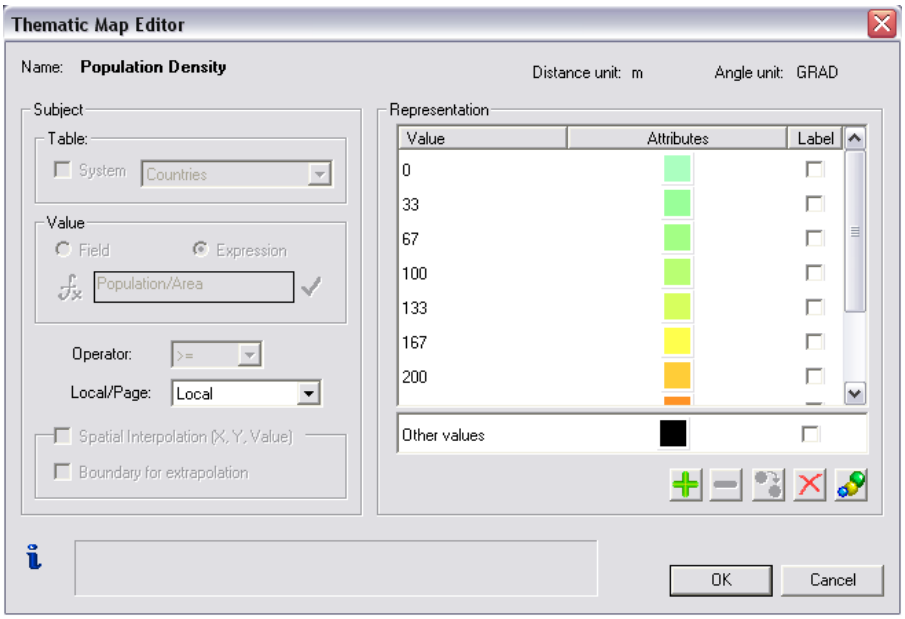
The thematic maps option ('File' → 'Thematic Maps…') allows you to create thematic maps based on certain criteria. Multiple thematic maps can be active simultaneously.

Thematic Map Manager

The "Thematic Map Manager" can be used to created new thematic maps. Existing maps can be copied, modified or deleted. The sequence in which the maps appear in the list, determines the thematic map that has precedence over the next one.

Thematic Map Editor

The Thematic Map Editor (click "New…" if no thematic map is created, then "Settings…") is used to specify the criteria for the map.



A table can be selected. This table contains the following Pythagoras object types: All objects, Points, All lines (also includes arcs, curves, etc.), Lines, Arcs, Circles, Spirals, Curves, Paths, Polygons, Texts, Images as well as all database tables in the active drawing (these tables were created using the menu 'File' → 'Database' → 'Database manager').

"Value" field allows you to specify the field and operator that need to be used for the theme. The fields, that are made available, are dependent on the "Table" that has been selected. E.g. if "All Objects" has been selected under

"Table", the "Field" options are limited to "Layer", "Display Level" and "Comment". If a table has been selected, then the list will consist of all field names in the specified table.
The list of operators depends on the field that has been selected. Numeric fields use different operators than text fields.

Also choose whether your thematic map settings should be applied to objects in Local or Page coordinates, or in both.

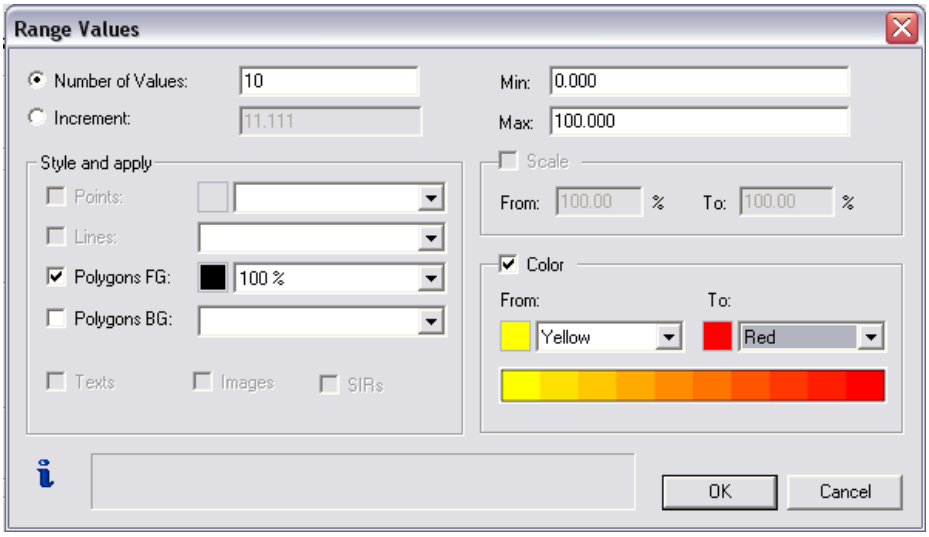
Representation

In "Representation" one or more values can be entered along with accompanying attributes such as color, style, etc.
Use the green "+" sign to add a new value. Use the "-" sign to delete a value. Click the row in the "Value" column to enter or select a value. Click the row in the "Attributes" column to specify the representation (the "Representation" window will pop up).

The attributes that can be specified depend on the field type that is used. A tab-page is available for each of the field types.
When selecting a color directly above the Tab-pages, this color will apply for all attributes, even if a different color has been specified for an individual field attribute.

Autofill

If you want to fill-in the representation settings for your thematic map automatically, press the 'Autofill' button. The 'Range Values' dialog will appear:



- First of all, you set either the number of values you want to show in the thematic map, or the increment and minimum and maximum value. In the both cases, Pythagoras will automatically calculate the remaining values.

- Style and apply: Choose the style that the thematic map will apply to objects. For example, coloring for polygons and symbols for points. Note, that if the polygons have no pattern attribute or if they are

opaque, you will not see the coloring of the resulting thematics applied to them.

- Scale: Indicates the range of scale change for symbols, line styles and patterns. For example, point style ranging from a small circle for a village to a huge circle for a big city.

- Color: If you are coloring your thematic map, choose the starting and the ending color, and Pythagoras will fill-in the color range according to the calculated number of values.

Note: *For texts, images and SIRs you can choose only color for building a thematic map. These objects do not have symbols as such and their scale cannot be changed.*

Special application: Spatial Interpolation

Measured values linked to a position, e.g. measure of air pollution, can be visualized by a thematic map.

Select the database and the corresponding field where the data can be found and mark "Spatial Interpolation" while defining a thematic. Only in this case you can make a selected polygon in the drawing the boundary for extrapolation of the thematic map.

Finally, choose for the "Autofill" function and finish your thematic.

Terrain models

The dialog window that follows ('File' → 'Terrain Models…') is used to manage the calculated terrain models.

Careful!
Any actions from this dialog window cannot be un-done!

Delete

The "Delete" command deletes the selected terrain model in the active drawing.

Rename

This command allows you to rename the selected terrain model in the active drawing.

Active

This command activates the selected terrain model. The terrain model will become visible if the corresponding settings in the Display View dialog are switched on (see PART II → Chapter 6: → Display View).
All coordinates are then calculated in reference to this terrain model.

Symbols

Symbol Manager

Using the dialog window "Symbol Manager" ('File' → 'Symbols' → 'Symbol Manager…'), the following operations can be executed on symbols, line styles and patterns:

- Move document symbols, line styles, etc. to the library.
- Change the group name.
- Change the name of a symbol, line style, etc.
- Delete a symbol, line style, etc. from the library or from a document.

Remarks:

- *Symbols, line styles, etc. used in one or more open documents cannot be deleted.*
- *The groups and symbols in the menus are sorted alphabetically.*

Create

Create Symbol

The command "Create Symbol" ('File' → 'Symbols' → 'Create' → 'Symbol…') allows you to make a symbol that is defined by a series of selected lines, arcs, circles, polygons and text.

In order to create a symbol, you first make a drawing of the symbol at the right size. The attributes line width, polygon patterns and color will be inherited by the symbol. When all elements of the symbol have the same color, the symbol can be given any color when it is used.

One point of the symbol must be indicated as being the "Hotspot" ('Format' → 'Point Style' → 'Hotspot'). When a symbol is used in a drawing, the coordinates of the symbol correspond with the coordinates of the hotspot. The position of the hotspot is indicated in the preview of the symbol.

Before calling the command "Create Symbol", all elements, inclusive the hotspots forming the segment must be selected.

The dialog "Create Symbol" will show in a window the symbol as it will appear in the drawing. The size of the symbol in this dialog box does not correspond with the real size of the symbol in the drawing.

1) Attributes of a symbol:

a) *Rotatable.*
Not rotatable symbols will always by printed in the same direction as they are defined. When the drawing is rotated, or if the angle of the drawing on the page is changed using "Select Print Area", not rotatable symbols will always remain horizontal. When rotatable symbols are created in the drawing without giving a direction, they will be treated by Pythagoras as not rotatable symbols.

b) *Scale Dependent.*
A scale dependent symbol has real dimensions. (For example, a symbol for an inspection cover of 1.5 meter). A symbol that is not scale dependent has dimensions that correspond with the size as it will be

printed. (For example, a small triangle indicating a station point with sides of 3mm. on paper.)
Scale independent symbols, that is, symbols which need to be printed or plotted independent of the scale of the drawing, are best created in page coordinates. It is also recommended selecting "mm" as the default unit for "distances". (See PART II → Chapter 5: The Defaults Menu).

c) *North Symbol.*
A north symbol will always orient itself to the north. A few characteristics:
- a north symbol cannot be rotated manually;
- may be used in page or local coordinates;
- by default, North corresponds to the Y-axis, in the mathematical sense, of the Local coordinate system of the drawing. The bearing of the Y-axis towards the real north can be specified for a document. This is called the "Bearing of the Drawing".

Note:
- *A symbol may contain a maximum of 64000 elements.*
- *If all elements of the symbol are of the same color, the color of the symbol can be changed when using the symbol in a drawing. However, if the symbol contains elements of different colors, you will not be able to change the color of the symbol when using it in a drawing.*

2) Library symbol - Document symbol

Symbols can be either placed in the library or in the active drawing. All remarks regarding this see in PART I → Chapter 2: → Symbols / Line Styles / Patterns.

3) Group - Symbol

The name of every symbol consists of 2 parts: group and symbol. After a symbol is created as a library or document symbol, it will appear in the menu's "Format" and "Defaults" under "Library Symbol" or "Document Symbol" depending on the choice made.

Create Line Style

The command "Create Line Style" ('File' → 'Symbols' → 'Create' → 'Line Style…') allows you to create a line style in which the repeating segment is formed by a series of selected lines, arcs, circles and polygons.

In order to create a line style, you first need to make a drawing of one segment at the right size. The starting point and the endpoint of the segment are indicated with a "Hotspot" ('Format' → 'Point Style' → 'Hotspot'). The position of the hotspots is indicated in the preview of the line style.

Once a new line style is created you can assign the style to lines, arcs and circles. The line will be created by placing the segments one after the other. Pythagoras will scale the segments in the X-direction so that always an integral number of segments are placed between the endpoints. As a user you don't see how the segments internally are built up. Such a line still has all attributes of a normal line.

The attributes line width, polygon pattern and *color*, used in the elements forming a segment, are used in the line style.

There are however a few exceptions to this rule:

1) Color: If all elements have the same color, lines of this style can be given any color.
2) Line width:
   a) The width of the line element that connects the two hotspots can be changed with the menu "Line Width" if there is only 1 horizontal line running from hotspot1.x to hotspot2.x.
   b) The width of all other line elements will be only sensible for "Line Width" if:
      - all line elements have the same width
      - there is either no line connecting the 2 hotspots, or there are multiple horizontal lines running from hotspot1.x to hotspot2.x.

Before calling the command "Create Line Style", all elements, inclusive the hotspots forming the segment must be selected.

The dialog "Create Line Style" will show in a dialog window the line (5 segments) as it will appear in the drawing. The size of this line does not correspond with the real size.

1) Attributes of a Line Style:

Scale dependent.
A scale dependent line style has real dimensions. (For example a line style for a railway with a rail width of 1.7 m.). A line style, which is not scale dependent, has dimensions corresponding with the size of the printout. (For example a line style with small crosses of 1mm. every 10 mm. on the line).

Scale independent.
Scale independent line styles, so line styles, which need to be printed or plotted independent of the scale of the drawing, can be best created in page coordinates. It is also recommended to select "mm" as the default unit for "distances". (See PART II → Chapter 5: The Defaults Menu).

2) Library Line Style - Document Line Style

Similarly to symbols, line styles can be either placed in the library or in the active drawing. All remarks made for symbols regarding Library and document apply also for line styles.
(See PART I → Chapter 2: → Symbols / Line Styles / Patterns).

3) Group - Symbol

The name of every line style consists of 2 parts: group and symbol. After a line style is created as a library or document line style, it will appear in the menu's "Format" and "Defaults" under "Library Line Style" or "Document Line Style" depending on the choice made.

Note:
- *A line style may consist of a maximum of 3 lines, and each line may consist of approximately 64000 elements.*
- *If all elements of a line style are of the same color, the color of the line can be changed when using the line style in a drawing. However, if the line style contains elements of different colors, you will not be able to change the color of the line when using the line style in a drawing.*
- *Line widths of the line elements (base line = the line that goes from hotspot to hotspot):*
  The line is "line-width-sensitive" for the base line itself, even if there is a base line without parallels of the same length. Line styles without base line, which contain different line widths, are "insensitive" to changes in the line width.

Create Pattern

The command "Create Pattern" ('File' → 'Symbols' → 'Create' → 'Pattern…') allows you to create patterns to fill polygons.

In order to create a pattern, you first need to draw a rectangle with dimensions that correspond with the dimensions of the pattern. Line width and color of the lines are retained in the pattern. When all lines have the same color, the pattern can be given any color. The boundaries of the pattern, namely 2 diagonal points of the rectangle are indicated with a Hotspot ('Format' → 'Point Style' → 'Hotspot'). The position of the hotspots is indicated in the preview of the pattern.

Elements of a pattern may be lines in any direction, arcs and circles. In the real hatch pattern, arcs and circles are split up in polylines with small segments.

Note: *It is recommended to use only horizontal, vertical and diagonal lines if possible. When using lines in other directions and/or arcs and circles, the pattern can become complex and drawing may become slow.*

1) Attributes of a pattern:

a) Scale dependent.
A scale dependent pattern has real dimensions. A pattern, which is not scale dependent, has dimensions corresponding with the size of the printout.

b) Scale independent.
Scale independent patterns, so patterns, which need to be printed or plotted independent of the scale of the drawing, can be best created in page coordinates. It is also recommended to select "mm" as the default unit for "distances". (See PART II → Chapter 5: The Defaults Menu).

Before calling the command "Create pattern", all elements that form the pattern, inclusive the hotspots must be selected. Lines of the rectangle forming the boundary may not be included in the selection, or should be removed, if they are not part of the pattern.

The dialog "Create Pattern" will depict the pattern in a window. The size of this preview corresponds with the real dimensions of the pattern as it will be printed.

c) Rotation angle.
When defining the pattern, the angle of the pattern relative to the page borders can be entered in the "Create Pattern" dialog box. The dialog window will always depict the pattern as it will be printed. For simple patterns, for example lines of 0.3mm at a distance of 3mm. and having an angle with the page of 45°, it is sufficient to draw 1 line of 0.3 mm. in a rectangle with a height of 3mm. By using the rotation angle of 45° the right pattern is created.

2) Library Pattern - Document Pattern

Similarly to symbols, patterns can be either placed in the library or in the active drawing. All remarks made for symbols regarding Library and document apply also for patterns.
(See PART I → Chapter 2: → Symbols / Line Styles / Patterns).

3) Group - Symbol

The name of every pattern consists of 2 parts: group and symbol. After a pattern is created as a library or document pattern, it will appear in the menu "Format" under "Library Pattern" or "Document Pattern" depending on the choice made.

Note:

- *A pattern may consist of a maximum of 64000 directions, and each direction may contain a maximum of 64000 elements.*
- *If all elements of a pattern are of the same color, the color of the pattern can be changed when using the pattern in a drawing. However, if the pattern contains different colors, you will not be able to change the color of the pattern when using it in a drawing.*

Create Typical Section

See PART III: Road Design.

Import System Symbols

All Pythagoras system symbols are stored in a file called PYTHAGOR.LIB. This command ('File' → 'Symbols' → 'Import System Symbols') allows you to import a symbol library.
Importing symbol libraries is used for:

- Copying a library to a computer where Pythagoras is newly installed.
- Restoring a backup of the PYTHAGOR.LIB file.
- Switching between Symbol Libraries.

This function overwrites PYTHAGOR.LIB with the Symbol Library that you have selected.
All documents should be closed before using this function.

Export System Symbols

This command ('File' → 'Symbols' → 'Export System Symbols') allows you to export the system symbol library. In fact this makes a copy of the PYTHAGOR.LIB file. It is used for:

- Creating backup of the PYTHAGOR.LIB file.
- Creation of multiple libraries. This allows switching easily between libraries. See 'Import System Symbols'.

Macros

Load Macro-library

Using 'Load Macro Library…' ('File' → 'Macros' → 'Load Macro Library…'), a dialog window pops up with a list of available Macro-libraries. Select the appropriate library by clicking on it.

Note: If only 1 library exists, no dialog window will pop up.

Macro-library manager

When selecting 'File' → 'Macros' → 'Macro Library Manager…', a window pops up that allows you to manage the macro libraries.

The principle is similar to managing symbols: you can move document-libraries to the system, you can rename libraries, delete, etc.

Startup library

You can assign one of the libraries as 'startup library'. This library is automatically loaded when starting Pythagoras. This can be really handy to automate certain routines while starting Pythagoras.

Locked

Locking libraries prevents users from being able to make changes to the macro code of certain libraries. The lock is activated by entering a name and a password. The lock can be 'unlocked' by entering the appropriate name and password.

Macro-editor

A macro-library becomes active the moment it is loaded. This provides access to the macrocodes, so you can make or edit your macro program.

When the Macro-editor ('File' → 'Macros' → 'Macro Editor') is active, the menus also change accordingly:

- '**File'** contains all commands relating to file management.
- '**Edit'** contains the edit commands that can be useful during programming, e.g. copy, paste, find, replace, etc.
- '**Run'** contains *compile* and *run*. *Compile* checks the program for errors, and converts it into machine language. *Run* compiles the program and runs it right away.

Please refer to the VBA-manual for more detailed information on programming in VBA.

Import System Macros

All Pythagoras system macros are stored in a file called PYTHAGOR.MLB. This command ('File' → 'Macros' → 'Import System Macros') allows you to import set of macro libraries.
Importing a set of macro libraries is used for:

- Copying a set of macro libraries to a computer where Pythagoras is newly installed.
- Restoring a backup of the PYTHAGOR.MLB file.
- Switching between sets of macro libraries.

This function overwrites PYTHAGOR.MLB with the set of macro libraries that you have selected.
All documents should be closed before using this function.

Export System Macros

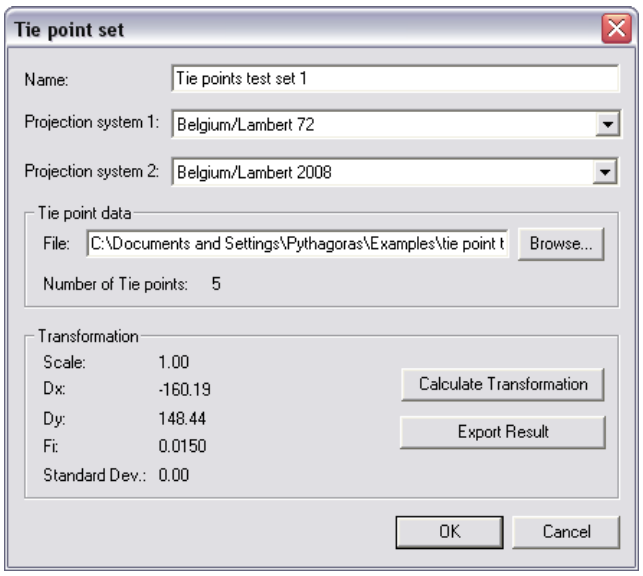
This command ('File' → 'Macros' → 'Export System Macros') allows you to export set of macro libraries. In fact this makes a copy of the PYTHAGOR.MLB file. It is used for:

- Creating backup of the PYTHAGOR.MLB file.
- Creation of multiple sets of libraries. This allows switching easily between them. See 'Import System Macros'.

Tie Points

The dialog window that follows ('File' → 'Tie Points…') is used to upload and manage sets of Tie points.

The principle of Tie Points library is similar to managing symbols: you can move document-libraries to the system; you can rename sets, delete, etc.

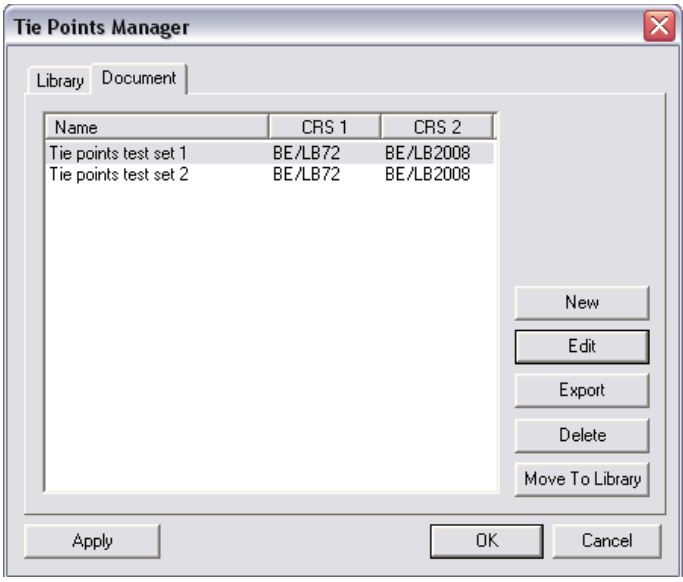


When you import a set of tie points into Pythagoras, you have to indicate the projection systems, which this set is connecting. The format of the tie point set ASCII file is described in PART I → Chapter 1: Coordinate Reference Systems.

Pythagoras will calculate the transformation for you if the data in the set is sufficient (press 'Calculate Transformation'). The 'Export Result' button creates you the ASCII file of the tie point set ready to pass to somebody else.
This is the result of the calculated transformation and the residuals of all the tie points. This file is not a tie point set ASCII file anymore.

After confirmation, the tie points set will appear in your library and you can proceed with further managing actions.

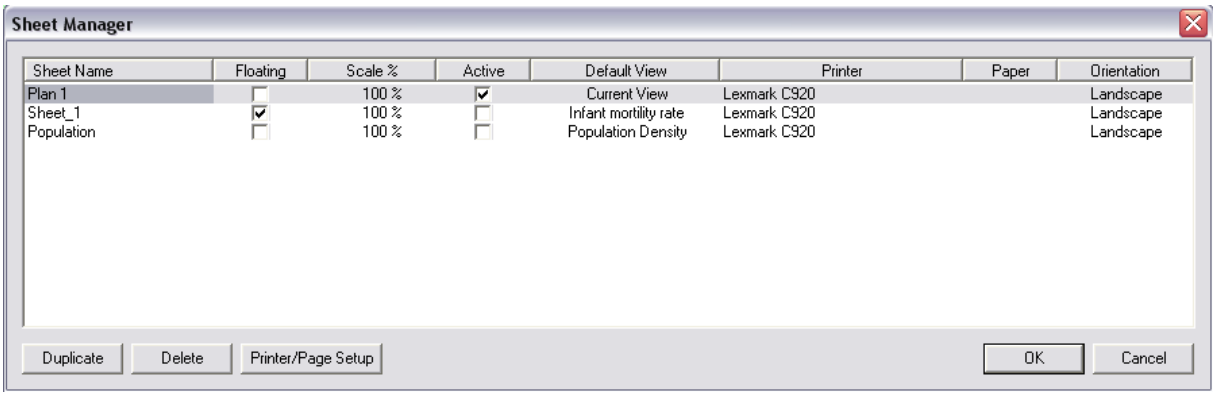
You can get back to the previous dialog to calculate and export the transformation any time by pressing the 'Edit' button.



Select Sheet (Print Sheet)

Sheet manager

Sheet Management allows you to create and control multiple print sheets per drawing.



The **'New'** button is used to create new print sheets. After creating a new print sheet, you can change certain properties using the menu options 'File' → 'Select Sheet' → 'Sheet manager…'.

If you already selected a sheet in the Sheet Manager Window, the 'New" button will change into a **'Duplicate'** button. This allows you to easily create a new sheet with the same properties, but possibly covering a different area of the drawing.

The **'Delete'** button is used to delete sheets.

To make a sheet ***floating***, simply click inside the "floating" column for the appropriate sheet. This setting will hide the page. It is used to perform, as it were, a 'Print screen' of your drawing. Simply zoom in on that part of the drawing that you would like to print out and give the print command ('File' → 'Print'). The "print screen" window that pops up allows you to fine-tune the position of the page. The screen will be slightly zoomed-out and the page will be shown in order to clearly show what will be printed. The Print command can be given directly from within this window. The number of copies that you would like printed, can then be specified in the next window that pops up.
A floating sheet can have page objects (objects in page coordinates) as well as a print area. The page objects only become visible when selecting "Page" as coordinates in the control panel.
When printing the sheet, the page objects are printout along with the drawing objects.

The column '***Scale%***' can contain a percentage. This is the percentage by which text objects, line styles, line widths, etc. will be scaled up or down upon printing.

The sheet that contains a little cross in the ***'Active'*** column is the sheet that is currently in use.

The column "Default View" indicates which "View" is active. This way, 2 identical sheets can look different, or, vice versa, the same theme (thematic maps) can be visible in 2 different sheets.

(Print) Sheet

This list ('File' → 'Select Sheet') shows all available (thus already created) sheets. The active sheet has a check mark in front of it. To activate another sheet, simply click on it.

Printer

With this function ('File' → 'Printer…') you can set up the printer: page format, orientation, etc. for the active print sheet. The dialog box appearing when you select Page Setup will depend on the printer, which is selected at that moment. For example, on an A0 plotter you have the option to select one of the many different page formats (A0, A1, A2, A3, A4). On a laser printer you will have fewer options.

This menu also allows you to change printers. A list of all installed printers will pop up. The actual default printer is selected. You can choose another printer freely. With the 'Settings' button you can eventually change the printer's settings.

When the Pythagoras drawing is made for a printer other than the one selected, Pythagoras will give a warning message. When you continue, the drawing will be adapted to the selected printer.

When page setup is confirmed, Pythagoras continues with the Select Print area command. (See below).

If you would like additional information on available printer settings, we would like to refer you to the documentation that accompanied your printer.

Select Print Area

This command ('File' → 'Select print area…') controls the transformation of Local coordinates in reference to Page coordinates.

When you select this command, or when the page settings (use of "Printer" command) are confirmed, the Control panel will display the Select Print Area dialog box.
The drawing window will display the page at reduced size. The page border will be indicated by a solid rectangle, the printable area will be indicated by a dashed rectangle.

You can always use the button '"Preview" to see the effect of the new settings.

The **scale factor** can be changed either manually, or by using the **"Fit on Page"** button. When pressing this button, Pythagoras will calculate the scale factor so that the complete drawing will fit on the page. Only the objects in the visible layers are taken into account and the center of the page remains.

The **rotation angle** can only be changed manually.

The **translation parameters** (x, y) can be changed in different ways:

- You may change them directly in the control panel.

- You may use the "Center" button. Pythagoras will calculate new values for the translation parameters so that the drawing will appear centered on the page. For the calculation of the center point of the document, only the visible layers are taken into account.
- When you move the mouse inside the page rectangle, the cursor will take the shape of a hand. You may drag the page over the drawing. When you keep the CTRL-key down while dragging the page, the page rectangle can only be moved horizontally and vertically. This can be very useful if you need to make several prints of a drawing using a small page format.

You can rotate the page relative to the drawing by moving the mouse to the corner of the page. The shape of the cursor will change, and subsequently you can rotate the page using the mouse. After rotation, you can use the button "Preview" to judge the layout.

The "Select Print Area" function can be cancelled at any time by pressing the "Cancel" button or using the Escape key.

The new settings become active by pressing the "Ok" button or by using the Enter-key on the keyboard.

Remarks:
- *You may use the zoom in, zoom out and scrolling functions any time in order to position the page more accurately.*
- *When the page rectangle is not visible (the page is completely outside the drawing), use the "Center" button to make the page rectangle visible.*

Also refer to the -button in the Toolbar.

Print

The print command will print or plot the active drawing.

Important to note is that a created 'View' will define the layout of your printout.

After selecting 'File' → 'Print…', a dialog box with 7 Tab pages pops up.

The selections will be identical to the display options (menu 'View' → 'Display View') selected at that moment. This means that if you confirm this dialog box without changing any selections, the drawing will be printed as it is displayed.

The first Tab Page called "Layers" allows you to select the layers that need to be printed.

The second Tab, called "Show" allows you to select the objects that need to be printed.

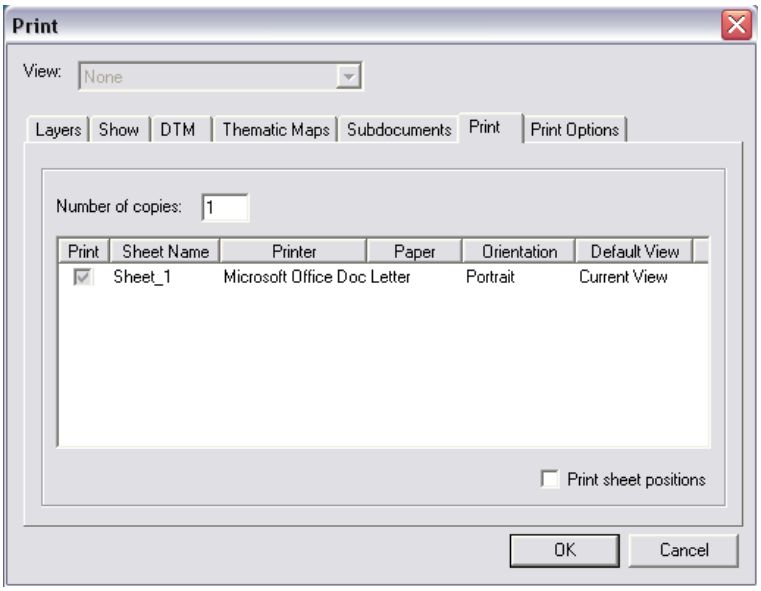
The next Tab, called "DTM" allows to select certain DTM options for printing (when applicable).

The Tab Page called "Thematic Maps" allows to select a thematic map to be printed.

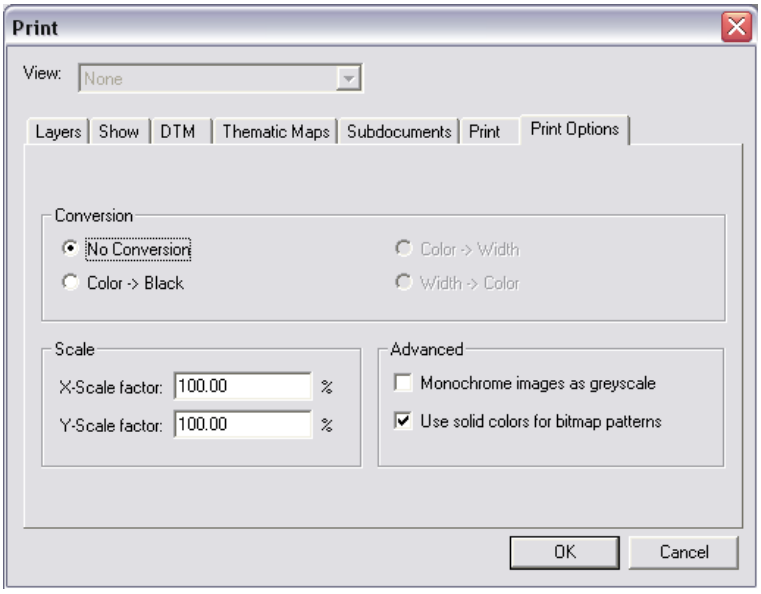
The Tab Page called "Subdocuments" allows changing the subdocuments that will be printed.

When a Sheet has a default View, all settings of the view, including thematic maps and subdocuments, will be applied when printing the sheet.

The Tab Page called "Print" allows you to select the sheets that need to be printed. Also, the number of copies that need to be printed can be specified.



Finally, the Tab Page "Print Options" allows you to convert data when sending it to the printer. The conversion "Color to Black" can always be selected. The other conversions can only be selected if a conversion table has been loaded. See PART II → Chapter 5: → Preferences explained further in this manual.



You can select:

- No conversion: this is the default.
- Color –> Black: all colors are converted to black.
- Color –> Width: the width of the objects in the drawing is ignored. The new width and the new color are obtained from the conversion table.
- Width –> Color: the color of the objects in the drawing is ignored. The new color and new width are obtained from the conversion table.

Only Windows

Plotting special colors in certain intensity percentages (75%, 50%, 25%…) can cause problems. Certain plotter-drivers do not support these colors and thus print a totally different color.

You can avoid this problem by checking on 'use solid colors for bitmap patterns'. Pythagoras will calculate similar colors and those colors will be sent to the printer as 100% color.

Also refer to the -button in the Toolbar

After confirmation, a printer-dependent dialog box will appear.

Recent documents

The names of the last 16 used Pythagoras drawings appear at the bottom of the 'File' menu Management ('File' → 'Recent Documents'). Clicking on a name in this list will automatically open the requested drawing.

Quit

The "Quit" command ('File' → 'Quit') closes all the windows on your screen and ends the Pythagoras session. If you have made changes to the drawings but have not saved them, Pythagoras will present a dialog box for each non-saved drawing.

When you quit, Pythagoras saves all session information to a file. The session information file contains the defaults and preferences, which were set at the moment you quit Pythagoras. The next time you start Pythagoras, this session information will be restored.

About

Pops up a dialog box that contains all relevant info on the current version of your copy of Pythagoras, as well as the coordinates for technical support on Pythagoras ('File' → 'About…').

You have also the possibility to open the configuration program by clicking on the 'Configure' button.

Chapter 2: The Edit Menu

Undo

The "Undo" command ( ) restores the drawing to the state prior to the last executed editing command.

The maximum number of undos is 25. Multiple undo levels can be very handy when you want to make constructions in order to obtain a result. You select the resulting point or line, place it on the clipboard, and call undo as many times as required to delete the intermediate construction. When all intermediate objects are removed, paste the result back on the drawing.

Remark: *A new editing command after Undo will clear the "undone" editing commands from the undo list!*

Redo

The "Redo" command ( ) reverses the Undo command.

Select

The "Select" command ('Edit' → 'Select') can select:

- all points
- all lines
- all texts
- all polygons
- all paths
- all coordinate systems
- all objects

The "all" applies to the visible layers, and either to the objects defined in Page coordinates or the objects defined in Local (and Global, and user) coordinates, depending on the coordinate system currently selected.

Find

This function ('Edit' → 'Find' → 'Find…' or the -button in the Toolbar) allows you to search for objects that satisfy specific criteria. The found objects can subsequently be selected.

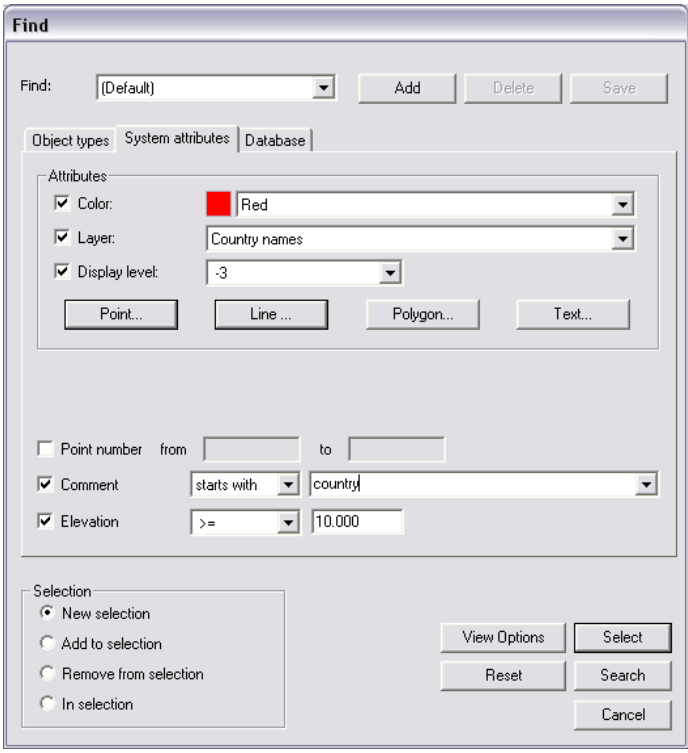
For example:

- search all blue texts in layer "Test";
- select all lines that are not red and are in layer "Test".

You can search for specific object types: points, paths, polygons, roads, images. You can also search for lines or specific types of lines: straight lines, arcs, circles, curves or spirals. You can also search for either simple text or rich text objects. In addition, you can define how to handle groups for each search: either as separate objects or as group objects. This option influences the highlighting and counting of found objects.

By selecting the "System Attributes" Tab, you can specify more search criteria.

<u>Note:</u> *A Rich Text object will be found only if the complete text has the specified attributes.*



Possible criteria:

- Color: objects must have the specified color.
- Layer: objects must be in the specified layer.
- Display level: objects need to have a specific display level.
- Style: objects must have the specified style. A style per type of object (line, point, polygon or text) is provided.
- Point number: from x to y.
  - If both x and y are filled in: all points with point numbers between x and y (values x and y are included).
  - If x and y are not filled in: all points without point number.
  - If only y is filled in: all points up to point number y.
  - If only x is filled in: all points starting from point number x.
- Comment: the comment (object information) of an object must be equal, start with or contain the given text.
- Elevation: height must be ±=, =, <= or >= a given value.

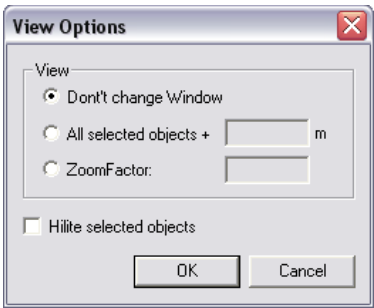
Finally, by selecting the Database Tab, you can also specify additional database search criteria, assuming a database has been created inside the Pythagoras drawing. Use the green "+" sign to add search criteria.

By using the button "Search", Pythagoras will search the objects that fulfill all given criteria. The number of objects found is displayed in the dialog box.

By using the button "Select", the objects found will be selected. You may:

- Make a completely new selection.
- Add to the selection: the objects found will be added to the already selected objects.
- Remove from the selection: the objects found will be deselected.
- Select from the already selected objects: only already selected objects satisfying the given criteria will remain selected.

When searching for groups option is selected, all objects of a group are highlighted if at least one member of this group matches the search criteria.



In the "Find" dialog box you will see a "View Options"-button. With this button you can define which part of the drawing you want to see when the Find command is executed.

With "All selected objects + …m" you will define a border with a given radius that needs to be displayed around the selected objects.

With the "Zoom Factor", a multiplicity factor will be set for the actual scale. With this, we mean the scale that is used when the drawing is plotted. This scale can be found by going to the "View" menu and by choosing "Actual scale". This actual scale can be read in the upper left corner of the control panel.

Another possibility is to leave the view as it is. To do this, you just select "Don't change window".

Consider that only the choice "All selected objects + …m" gives you the certainty that after the find command all objects found will be displayed.

The checkbox "Highlight selected objects" will not only select the objects found, but they will also be blinking. Hitting the "escape" button will stop the blinking.

To save your settings for the next search, press the button ‘Add’ in the upper part of the Find dialog and enter a name. The name together with parameters will be stored in the .DEF file. You can load saved Finds (also called "Named Find") by selecting them from the list. All "Named Finds" will be listed in the submenu "Edit, Find". When selecting a "Named Find", the corresponding Find will be executed.

Cut

The cut command ( ) will clear the selected objects, and copy them to the clipboard.

The coordinates are written on the clipboard relative to the selected coordinate system.

Copy

The copy command ( ) will copy the selected objects, and their attributes to a clipboard.

The coordinates are written on the clipboard relative to the selected coordinate system.

There is a difference between the Pythagoras clipboard and the Operating System's (OS) clipboard.

Pythagoras Clipboard

Copying objects to the Pythagoras clipboard means they can only be used inside Pythagoras. This is the default "Copy" command. It is used to copy objects from one drawing into another.

OS Clipboard

Copying to the OS clipboard allows you to directly insert data (using "paste") into other applications (such as MS Word, MS Excel, etc.), but not into Pythagoras. Drawings made in Pythagoras can so be used to illustrate documents in other applications.

Copy Active Terrain Model

Pythagoras allows you to copy the active terrain model. To do that you need to make the DTM active. Then choose 'Edit' → 'Copy' → 'Active Terrain Model'.

Paste

The paste command ( ) will copy all objects and their attributes from the clipboard to the active drawing.

Coordinates read from the clipboard, are considered relative to the selected coordinate system.
Also the elevation of the origin of the coordinate system is taken into account.

When you copy part of a drawing when the user coordinate system CS S1-S2 is selected and you select Paste in CS S3-S4, then a transformation (translation and rotation) will be done and also the elevation will be adapted.

Paste in an empty document will automatically adapt the scale of the drawing to the scale of the information on the clipboard. When the data on the clipboard is in global coordinates, the new document will automatically switch to global coordinates using the same transformation.

When you paste in a User Coordinate System, and there is a difference in distance between the coordinate system on the Clipboard and the active coordinate system, a warning will be given. You may then either paste the objects with or without scaling.

If the clipboard contains a DTM (see Copy Active Terrain Model), this DTM will be pasted in the drawing.

Paste Special

The "Paste Special" command ('Edit' → 'Paste Special') will bring up a dialog box requesting a scale factor.

All coordinates on the clipboard will be scaled with the given factor before copying the objects to the active drawing.

Mirror: the mirror axes can be the X-axis and/or the Y-axis.

With the button "Adjust sketch" you can perfectly insert an earlier made sketch in your drawing. Select the objects in your sketch and copy them to the clipboard. Open the drawing containing the points with exact coordinates and select 'Edit' → 'Paste Special'. By checking the "Adjust sketch" button and clicking "OK", the sketch will be properly inserted in your drawing. CAUTION: The point numbers must be the same in both drawings.

Clear

The "Clear" command ('Edit' → 'Clear') removes the selected objects from the drawing.

When a selected object is used by another object and that last object is not selected, the selected object will not be removed. For example: the endpoint of a line cannot be removed if the line is not removed.

Note: *Coordinate systems also use the points making up the coordinate system (see PART II → Chapter 3: → Commonly used tools: User Coordinate System).*

Cut Off

The "Cut off" command ('Edit' → 'Cut off') removes all objects (raster and vector information) inside or outside an arbitrarily area. Objects on the edge will be cut off (exception: texts and symbols). This item can only be chosen when exactly one polygon is selected.

Note: *With images, the content of multiple polygons can be cleared.*

The following functions can be selected:

- Clipping vector raster information simultaneously
- Only vector information
- Only raster information
- Only terrain model

This way you can select random areas from maps and use them to print or copy to another drawing. The edges are nicely cut.

Remarks:

- *Careless saving of the map to the disk after clipping will change the original of the drawing. Consider that clipping erases part of the map!*
- *Clipping will only erase visible objects. As a consequence, layers that have been turned off or which are not visible is the actual scale, will not be clipped.*

Move

The "Move" command ('Edit' → 'Move') allows you to move selected objects to another location.
When the Move command is selected, the shape of the cursor will change. Place the cursor on one of the selected points, press the mouse button, and drag the objects to the new position.

Note: *When the polygon areas are displayed and areas change while dragging objects, the new areas are continuously displayed.*

Warning: *The Move command changes the coordinates of the points moved. Do not use these commands to position your main drawing relative to the page. The Select Print area command is provided for this purpose (see PART II → Chapter 1: → Select Print Area).*

Rotate

The "Rotate" command ('Edit' → 'Rotate') allows you to rotate selected objects around a given position.
When the "Rotate" command is selected, you need first to click on a point around which the selected objects will be rotated. Next, you drag the selected objects around this object.

Warning: *The "Rotate" command changes the coordinates of the points rotated.*
Do not use these commands to position your main drawing relative to the page. The Select Print area command is provided for this purpose (see PART II → Chapter 1: → Select Print Area).

Texts are normally automatically oriented so that they are not displayed upside-down, even when the document is rotated. There are however 2 exceptions:

- When you select a single text and turn it upside down, the new orientation is retained.
- Dimensioning of points relative to a reference line (xy-offset), will always place the dimensions in the direction of the reference line.

Duplicate

The "Duplicate" command ('Edit' → 'Duplicate') will make a copy of the selected objects.
The duplicated objects will be placed on the drawing at a small distance of the original objects and will be selected.

Note:

- *Duplicated points will not get a point number.*
- *Comments belonging to objects will not be copied.*

Delete Coordinate System

The "Delete Coordinate System" command ('Edit' → 'Delete Coordinate System') will remove the selected (active) coordinate system.

Adapt

Save All Edited Images…

All edited images (cut off, erasing,…) can be saved into a folder. The names of the images remain the same.

This function ('Edit' → 'Adapt' → 'Save All Edited Images') is only activated when more than one image is modified. This means that this function will not be activated when a drawing contains just 1 image. In this case you'll need to double click on the image to save the changes with another name.

Convert to polylines

This command ('Edit' → 'Adapt' → 'Convert to polylines') converts strings of lines into polylines. The reduced number of objects after this operation is an advantage. The big disadvantage is the loss of points, point numbers and comments. Snapping to the points is still possible.
This conversion will occur for the selected objects in ALL visible layers. It is advisable to use this function only on layers which contain background information and which are not used to make constructions.

Local → Page

This function ('Edit' → 'Adapt' → 'Local -> Page') moves objects from the Local CS to the Page CS.

Page → Local

This function ('Edit' → 'Adapt' → 'Page -> Local') moves objects from the Page CS to the Local CS.

Group

The "Group" command ('Edit' → 'Group') will combine the selected objects in one group. Objects belonging to the same group will all be selected when you click the mouse on any of the objects belonging to the same group.

The individual elements of the group can, however, still be edited by double-clicking the appropriate object.

Ungroup

The "Ungroup" command ('Edit' → 'UnGroup') will restore all items of a group as individual items.

Unpack

The command "Unpack" ('Edit' → 'Unpack') will divide the selected symbols and special line styles in separate elements.

Set Print Area

With "Set Print Area" ('Edit' → 'Set Print Area') you can define random polygons as a print area. All objects outside this polygon will not appear on the printout. Objects partially inside the polygon will be clipped accordingly.

Unlike the clipping command, the definition of a print area does not affect the drawing itself.

Besides, a print area is always page dependent, i.e. it describes an outline of the page, not of the drawing. If the page is moved or rotated, the print area will change with it accordingly.

The "Set print area" command is only active in the page coordinate system. Thus, the polygon that describes the print area must be drawn in page coordinates. An already existing print area will automatically be removed at the moment the new definition occurs. In other words, it is not possible to activate more than one print area at a time.

Clear Print Area

Using "Clear Print Area" ('Edit' → 'Clear Print Area') you can deactivate a previously created print area.

Chapter 3: The Tools Menu

Introduction

Pythagoras provides several basic drawing objects to enable you to create your drawing. This section describes the information on the commands used to draw and select the basic objects.

Note:
- *Most object tools in the Tools menu can also be invoked with a button in the toolbox of the Pythagoras control panel.*
- *Using the SPACEBAR on the keyboard, you can toggle between select mode and the last used toolbox mode.*

Use of the Escape Key While Creating Objects

Creation of an object is aborted when you press the escape key. This feature may also be used to obtain the distance between two points or the perpendicular distance of a point to a line. Start drawing the line, which would give you the distance you want to know. When drawing the line, the control panel will display its length. When the cursor is at the endpoint, (you can be sure when the sight is displayed), the distance you want to know is displayed in the control panel. You can now press the escape key and the line drawing will be aborted.

Entering the Location of an Object Using the Control Panel

When creating points or lines, and the location of a point is not exactly defined, Pythagoras will prompt you to enter information in the control panel in order to define the location of the object. The control panel contains the following entry fields:

- The coordinate fields: in these fields the rectangular or polar coordinates of a point can be entered.
- Two distance fields: in these fields you can enter the distance of a point to the endpoints of an existing line.
- The line length field: in this field you can enter the length of a line you want to create.
- The perpendicular distance field: in this field you can enter the perpendicular distance of a point to a reference line.

The last two fields use the same position on the screen. The letters "L" (Length) and "D" (Distance) indicate the meaning the field has at a given moment.

When you will be prompted to enter information to define the position of a point, one of the above entry fields will become the first field to be given in. You can use the TAB-key to move to the next field. Pythagoras will only allow you to edit the fields, which may be changed in the given context. If, for example, the endpoint of a new line is on another existing line, then you can either enter (1) the distance to one of the endpoints of the existing line or (2) the length of the new line.

When you press the TAB key, all fields in the control panel will be recalculated and the position of the point or line will appear in the drawing. To confirm the data you have entered, press the enter key or use the Ok-button in the control panel. The Cancel button or Escape key will abort the operation.

Note: In the distance fields you may enter negative values, indicating that a point needs to be created at the given distance but outside the line segment.

Commonly used tools

Point

The point is the most fundamental object of Pythagoras. Surveying requires that the exact position of each point is known. Pythagoras assists you in entering the measured points, and in creating new points at locations, and with the restrictions you define.
Importing points from survey field data can be done either manually, or automatically using the import command. The import command is described in PART II → Chapter 1: → Import.

To create points manually, you select the point toolbox item in the control panel or you select the "Point" item from the "Drawing Tools" menu. The shape of the cursor will change to indicate that you want to create new points.

Creating a Point using its Coordinates

Before creating new points, you need to verify that the coordinate system and the preferences are set correctly. If not you first need to change them.

Position the cursor at any position of the screen, but not on a line, and press the mouse button. Pythagoras will now prompt you to type in the coordinates of the point, unless you have switched off the Defaults menu item "Point Confirmation" ('Defaults' → 'Document Default' → 'Confirm Operation').

As has been explained in the section about the Pythagoras control panel, you can define the coordinates in any of the coordinate systems, and in either polar or rectangular coordinates.

If you want to create multiple points, press the Caps Lock key. This key remains locked until you unlock it. When the coordinates of a point are confirmed, the point is created and Pythagoras will prompt you again for the coordinates of the next point. If you do not want any new points, press the Escape key or click on the cancel button to abort the operation.

Creating a Point on a Line

You may create a point on an existing line by moving the cursor to a line. When you press the mouse button if the "sight" is displayed, Pythagoras will prompt you to enter the distance of the new point to one of the end points of the line. Pythagoras will calculate the exact coordinates of the point. Interpolation will be used to calculate the elevation of the point.

When the Caps Lock key is on, you can quickly define multiple points on the same line by entering distance of the line end points.

Note:

- *The style of a new created point will depend on the default point style (See* PART II → Chapter 5: The Defaults Menu*).*
- *When you press one of the numeric keys 2..9, a Sight will be displayed. When pressing a digit "n", the line will be divided into "n" equal parts. The cursor will only snap to the points, which make up the line parts.*
  This way you can quickly create points subdividing lines in equal parts.

Changing the z-value of an existing point

If you hold the CTRL or ALT-key down and double click on a point, you get to possibility to adapt the z-value in the control panel.

Creating a point on a path

If you have created a path, and would like to create points along the path, select CDZ (instead of e.g. XYZ or NEZ) from the control panel. When placing points, you will be able to enter coordinates directly in CDZ format.

Note: *If you would like to place a point ON the path, it is best to click NEXT TO the path to place your initial point, then enter the exact C value, change the D value to zero (i.e. on the path), and enter the Z value if needed.*

Line

The Pythagoras line drawing mode allows you to create lines in any direction.

In Pythagoras a line is defined by the coordinates of its end points. When a line is created and one or both of its end points do not exist, they are created.

If the toolbox item "Lines" is selected, the shape of the cursor will change to a crosshair. When you move the cursor over the drawing, the shape of the "sight" will indicate that the cursor is on a point or on a line.

The end point (starting point or end point) of the line can be:
- an existing point,
- a point on an existing line,
- a point defined by its coordinates.

The simplest case is to connect two existing points. You move the cursor to the starting point, click the mouse button, move the cursor to the end point and click again. Because both end points are known by Pythagoras, the new line can be created.
When the starting point has been fixed, a line on the screen will follow all mouse movement. Even now, you are able to scroll in the drawing, zoom-in and zoom-out.

Note: *When you press the CTRL key, the line will remain parallel to the X or Y-axis of the active coordinate system.*

When the starting point is not an existing point, its location is defined the same way as the location of a single point (see "Point").
The end point of a line can be on another line. In this case, Pythagoras will give you the option to enter the length of the new line. The end point of the new line will be the intersection of the existing line and a circle.

Note:

- *The style and the width of a new created line will depend on the default line style and on the default line width (see PART II → Chapter 5: The Defaults Menu).*
- *The endpoint of a line you are creating will snap to the following points:*
  - *The point on an existing line where the new line is perpendicular to the existing line.*
  - *The point on an arc or circle where the new line is tangential to the arc or circle.*
  - *The point on an arc or circle where the new line is perpendicular to the arc or circle.*
  - *The point on an arc or line at an interval of 1/2 .. 1/9 of its length when the corresponding numeric key is pressed.*

During the creation of a line the control panel will show extra information about the line. By default the control panel shows the horizontal distance (L). However by using the TAB-key, the control panel will show the slope distance (S), the height difference (dZ), the gradient (%) and the bearing (B).

Lines with arrows at the endpoints

To create new lines with arrows at the end, switch the menu item "Line Arrows" in the menu "Defaults" to on. If the switch "Line Arrows" is on, lines at both ends will have an arrow. To suppress the arrow at one of the endpoints, hold the SHIFT-key while you are creating that end point.

To return to the normal lines, turn the "Line Arrows" option in the "Defaults" menu off.
To add or delete arrows on an existing line, select the line and the endpoint(s) that you want to change. Then, select "On" or "Off" in the menu 'Format' → 'Line Arrows'. You can only change the line arrows if you also select the endpoints of the line.

Note: *Pressing the SHIFT-key when you confirm the second point of a line, will start a new line. This can be very practical if you want to draw a series of connected lines, with only arrows at the starting point and at the endpoint of the polyline. If you want to draw a single line with one arrow, start at the end without arrow, while holding down the SHIFT-key and release the SHIFT-key while confirming the other end.*

Parallel Lines

The toolbox item "Parallel line" allows you to create lines parallel to other lines. When the toolbox item is selected, the cursor changes to a symbol representing parallel lines. You indicate the reference line by clicking the mouse button on the desired line, and the parallel-to symbol will be placed on the reference line.

The starting point of a parallel line can be:

- An existing point,
- A point on an existing line,
- A point defined by its coordinates.

When the starting point is a point on an existing line, Pythagoras will give you the option to enter either the distance to one of the end points of the existing line, or to enter the perpendicular distance to the reference line, arc or circle. The first field prompted in the Pythagoras control panel is the perpendicular distance, but using the TAB key allows you to enter data into one of the other fields.

When the starting point is defined, the new line will follow the mouse movements, but remain parallel to the reference line. When moving the mouse, Pythagoras will automatically calculate the intersection when the endpoint is near a line. The Sight will clearly indicate the intersection. When an intersection is indicated, you only need to click the mouse button to create the parallel line.

When you click the mouse button if the endpoint of the new line is not on a line, Pythagoras will prompt you to enter the line length in the control panel.

Note: The begin point of a parallel line may be one of the end points of the reference line.

Tangential Line

The toolbox item "Parallel Line" (also used to draw parallel lines) allows you to create lines either:

- Tangential to a circle or arc.
- Tangential to 2 circles or arcs.
- Tangential to a circle or arc and perpendicular to a line.

You indicate the first circle (or arc) by clicking on the desired object. As you will note when you move the mouse, the line will remain tangential to the indicated circle or arc.

When the starting point at the line comes close to an existing point on the arc or circle, the starting point will snap to that point.

When you move the mouse near the point of a circle or arc where the line is tangential to both objects, a Sight will appear.

When the mouse is near the point on an existing line so that the line is tangential to the circle or arc and perpendicular to the line, a Sight indicating the perpendicular position will appear.

When you click the mouse button while the Sight is displayed, the line will be created.

Perpendicular Line

The toolbox item "Perpendicular line" allows you to create lines perpendicular to other lines. When the toolbox item is selected, the cursor changes to a T symbol. You indicate the reference line by clicking the mouse button on the desired line, and the perpendicular on symbol will be placed on the reference line.

The starting point of a perpendicular line can be:

- An existing point,
- A point on an existing line,
- A point defined by its coordinates.

When the starting point is a point on an existing line, Pythagoras will give you the option to enter either the distance to one of the endpoints of the existing line, or to enter the perpendicular distance to the reference line. The first field prompted in the Pythagoras control panel is the perpendicular distance, but using the TAB key allows you to enter one of the other fields.

When the starting point is defined, the new line will follow the mouse movements, but remain perpendicular to the reference line. When moving

the mouse, Pythagoras will automatically calculate the intersection when the end point is near a line. The "sight" will clearly indicate the intersection. When an intersection is indicated, you only need to click the mouse button to create the perpendicular line.

If the endpoint of the new line is not on a line, when you click the mouse button, Pythagoras will prompt you to enter the line length in the control panel.

Perpendicular line to an arc

With the toolbox item "Perpendicular Line" you also can create perpendicular lines to arcs or circles.

You first click on the arc or circle to which the line needs to be perpendicular. As you will note when you move the mouse, the line will remain perpendicular.

When the starting point of the line comes close to an existing point on the arc or circle, the starting point will snap to that point.

Arc

Arc tangential to line or arc

The toolbox item "Tangential Arc" allows you to create an arc, which is either tangential to an existing arc or tangential to an existing line.

You click on the desired arc or line, then you enter the distance to one of the endpoints. This point will be the starting point for the arc.

You may now move the mouse to an existing object or to an approximate position. If clicked on an approximate position, you may enter angle and radius of the new arc or the coordinates of the endpoint.

You can also create tangential arcs while you are drawing a line. Start drawing the line, and move the mouse so that the line has the direction of the starting point of the arc. Press the SPACE bar and the line will convert in an arc tangential to the line that was seen on the drawing before the SPACE bar was pressed.

Note:

- *You change the direction of the arc by moving the mouse close to the starting point (within approx. 2 mm) and then moving the mouse in the other direction.*
  When the starting point of the arc is the endpoint of an existing arc or line, you may click on the endpoint and no distance needs to be entered. (If more than one line or arc has the same endpoint, you need to move the Sight over the desired line or arc towards the endpoint).
- *The endpoint of the arc you are creating will automatically snap to the following points:*
  - *Existing point.*
  - *Points on an existing line or circle where the new arc is tangential to that object.*
  - *Point on an existing line where the new arc is perpendicular to the existing line.*

Arc tangential to two lines, two arcs or a line and an arc

The toolbox item "Arc Tangential to 2 Lines" allows you to create an arc, which is tangential to either 2 lines, 2 arcs or a line and an arc.

When this toolbox is selected, the cursor changes into two parallel lines. Click consecutively on the lines/arcs to which the arc needs to be tangential. When moving the mouse, an arc will be shown tangential to both objects.

When you now click the mouse on an appropriate position, you either enter the radius of the arc or the coordinates of a point on the arc.

Note:

- *When you press the CTRL key while you confirm the arc, the reference lines will be trimmed or extended up to the point of contact.*
- *The cursor on the new arc will automatically snap to the following points:*
  - *Existing point.*
  - *Existing line or arc.*
  - *Point on an existing line where the new arc is tangential to that line (the new arc will then be tangential to three lines).*
- *The new arc may be drawn in any of the 4 segments formed by the 2 lines you have indicated.*

Two arcs through 3 points

This operation creates two arcs: one starting in the first point and ending in the intermediate point, and another starting from the intermediate point up to the endpoint. In that way the height of the second point is taken into account.

Arc with a given center and radius

After clicking the toolbox item "Arc with a given center and radius", click first on an existing point to indicate the center point.

Then click either on an existing object or on an approximate position to define the starting point of the arc. When you move the mouse, an arc with a fixed radius will be drawn following the movements of the mouse.

Pythagoras will automatically calculate the intersection when the endpoint is near another object (line, arc, circle). The Sight will clearly indicate the intersection.

When the endpoint is not an existing object, you need to enter the radius of the arc.

Note: When you press the CTRL key while you confirm the arc, a point at the center of the arc will be created.

Arcs with arrows at the endpoints

To create new arcs with arrows at the end, switch on the menu item "Line Arrows" in the menu "Defaults". If the switch "Line Arrows" is on, arcs at both ends will have an arrow. To suppress the arrow at one of the endpoints hold the SHIFT-key while you are creating that end point.

To return to the normal lines, turn the 'Line Arrows' option in the 'Defaults' menu off.

To add or delete arrows on an existing arc, select the line and the endpoint(s) that you want to change. Then, select "On" or "Off" in the menu 'Format' → 'Line Arrows'. You can only change the arc arrows if you also select the endpoints of the arc.

Note:

- *Pressing the SHIFT-key when you confirm the second point of an arc, will start a new arc. This can be very practical if you want to draw a series of connected arcs, with only arrows at the starting point and at the endpoint of the polyline. If you want to draw a single arc with one arrow, start at the end without arrow, while holding down the SHIFT-key and release the SHIFT-key while confirming the other end.*
- *The elevations of the points on the arc correspond to the elevation of the projection of these points on the chord of the arc. This also applies to spirals (clothoids) and splines.*

Circle

Circle with a given center and radius

After clicking the toolbox item "Circle with a given center and radius", click first on an existing point to indicate the center point.
Then click either on an existing object or on an approximate position to define the starting point of the arc. When you move the mouse, the circle with a fixed radius will be drawn following the movements of the mouse.

When the endpoint is not an existing object, you need to enter the radius of the arc.

Note:

- *When you press the CTRL key while you confirm the circle, a point at the center of the circle will be created.*
- *The cursor on the new circle will automatically snap to the following points:*
  - *Existing point.*
  - *Existing line or circle.*
  - *Point on an existing line, arc or circle where the new circle is tangential to that object.*

Circle through 3 points

When the toolbox item "Circle through 3 points" is selected, the cursor will change to an arrow with a P.
Click 3 points on the circle circumference. The circle will now be created.

Note: When you press the CTRL key while you confirm the circle, a point at the center of the circle will be created.

Parallel Lines / Arcs / Circles

The toolbox item "Parallel Objects" allows you to create lines, arcs and circles, which remain parallel to the referenced object.

When the toolbox is selected, the cursor changes to a symbol representing parallel objects. You may now click the mouse button on a line, an arc or a circle. What happens will depend on the type of object you clicked:

Mouse clicked on a line
When the mouse button is clicked on a line, a new line parallel to the reference line will be displayed following the mouse movements. This new line has the same length as the reference line.

Mouse clicked on an arc
In this case, a new arc parallel to the referenced arc will be displayed following the mouse movements. This new arc has the same aperture angle as the reference arc.

Mouse clicked on a circle
In this case, a new circle with the same center as the referenced circle will be displayed following the mouse movements.

When you click the mouse button on an approximate position, Pythagoras will prompt you to enter the distance between the referenced and the new object. You may also enter the coordinates of a point on the new object.

Mouse clicked on the snapping point of a polygon
When the mouse is clicked on a polygon, a polyline parallel to the polygon will be formed. The polyline will consist of separate lines and arcs with endpoints. The coordinates of the intersections are calculated, and because these are ordinary points, point numbers will be assigned automatically.

Mouse clicked on the snapping point of a path
When the mouse is clicked on a path, a polyline parallel to the path will be formed. The polyline will consist of separate lines and arcs with endpoints. The coordinates of the intersections are calculated, and because these are ordinary points, point numbers will be assigned automatically.

Note:
The cursor on the new object will automatically snap to the following points:
- *Existing point.*
- *Existing line, arc or circle.*
- *This function allows you to create roads easily.*

Text

The toolbox item "Title Text" allows you to create horizontal text. Use the SPACE bar to change the orientation 90°. The text will then be displayed vertically.
The text remains horizontal even if the local coordinate system is rotated using the "Select Print area" command.

When the toolbox item "Text" is selected, the cursor will change to a vertical bar. The size of this vertical bar will depend on the default point size and on the actual zoom factor. The bottom of this vertical bar will correspond with the underline position of the new text.

When the text cursor is moved close to points, lines or arcs you can make the text cursor snap to the object by pressing the CTRL-key.

When you click the mouse button on a position on the screen, the "Edit Text" dialog box will appear. You can enter text and change the default text attributes, which are displayed in this dialog box:
- Horizontal alignment: Left, Centered, Right
- Vertical alignment: Top, Centered, Bottom
- Point size: 4 - 72 point. (1 point = ± 0.3 mm).
- Style: Normal, Italic
- Width: Light, Normal, Bold, Extra Bold

- Color
- Underline: None, Single, Double, Dashed
- Border: No Border, Single, Double.
- Line spacing: Small, Normal, Large
- Layer: The names of the available layers.

Remark: The border is not exported in DXF format.

You may enter multiple lines of text. By using the Return-key you go to a new line.
The number of characters in a text is limited to 254.

You confirm the text object by pressing the Ok button, by using the Enter-key (on the numeric keyboard) or by pressing the Return-key in combination with the Command / Alt / CTRL key.

When you confirm this dialog box, the text will appear on the screen on the position where the mouse was clicked. The text can be left aligned, right aligned or centered relative to the given position.

Text can always be dragged to another location.

Note: An alternative to this text is to use the "Rich Text". Rich Text is not limited in the number of characters and allows to mix multiple fonts, styles, etc. within one text block. For more information see PART II → Chapter 3: → New Object: Rich Text.

Object Text

The toolbox item "Object Text" allows you to create text parallel to or perpendicular to a line. Use the SPACE bar to change the orientation with 90°. When the drawing is rotated using the "Select Print area" command, object text will rotate with the drawing, provided that the object text is not defined in page coordinates.

When the toolbox item "Object Text" is selected, the cursor will change to a parallel symbol. You need to click to a line to indicate the direction of the text. The cursor will change to a line, which is perpendicular to the reference line. The size of the object text cursor will depend on the default point size and on the actual zoom factor. The bottom of this line will correspond with the underline position of new text. When you click the mouse button on a position on the screen, the "Edit Text" dialog box will appear. You can enter text and change the default text attributes, which are displayed in this dialog box. For more information about the attributes see the above item "Text". When you confirm this dialog box, the text will appear on the screen on the position where the mouse was clicked. The text can be left aligned, right aligned or centered relative to the given position.

Object Text can always be dragged to another location.

Note: An alternative to this text is to use the "Rich Text". Rich Text is not limited in the number of characters and allows to mix multiple fonts, styles, etc. within one text block. For more information see PART II → Chapter 3: → New Object: Rich Text.

Polygon

The toolbox item "Polygon" allows you to create a polygon.
You create a polygon by sequentially selecting the points or arcs, which make up the polygon. The polygon you are creating will be indicated on the

screen using bold lines representing the border of it. Pythagoras will calculate the area, the perimeter and the center of gravity.

A polygon can be filled with a fill pattern, the area and perimeter can be displayed, and when using the object tools "Measurement" or "Annotation" texts containing area and perimeter can be created on the drawing.
You can align the fill pattern (created by user) with a given direction and having a specified origin. To align a polygon pattern you need to execute the following steps:

- Create pattern (see PART II → Chapter 1: → Symbols: Create Pattern)
- Create a user coordinate system. For example corresponding to a leg of the polygon.
- Select the polygon(s).
- Select "Align Pattern" in the "Format" menu ('Format' → 'Align' → 'Pattern'). *Note: Pattern should be created by user.*

The fill pattern will be aligned with the direction of the active user coordinate system. The origin of the fill pattern will correspond with the origin of the coordinate system.

Note:

- *You may define a Polygon of a circle. Instead of clicking a point, click on the circle and a polygon on the circumference of the circle is created.*
- *While creating the polygon, you can use the BACKSPACE key to remove the last point or arc from the polygon.*
- *When creating a polygon by clicking in a region, it happens that new points and/or arcs need to be created. Pythagoras will create these objects in a System Layer that remains invisible.*

Remarks:

- *During the creation of a polygon, you may "double click" on a line or arc. Pythagoras will automatically add all lines and arcs, in the given direction, to the polygon up to a point where the lines stop or a junction is encountered. When stopped, the polygon is not yet created and more objects can still be added.*
- *If the O-key is down in selection mode, Pythagoras will only search for polygons, and indicate the polygon closest to the cursor.*
- *When the mouse is clicked on the snapping point of a polygon, a polyline parallel to the polygon will be formed. The polyline will consist of separate lines and arcs with endpoints. The coordinates of the intersections are calculated, and because these are ordinary points, point numbers will be assigned automatically.*

Path

A path is a sequence of points, lines and arcs. The objects to which the path refers remain, however, separate entities in the document.

After the selection of the tool "Path", you can create a path by selecting - in the right sequence - the points, lines and arcs forming the path. The end of the path, (the last object) is indicated by:
a) Reselection of the first point of the path or,
b) Pressing the CTRL key when the last point or arc is selected.

The path you just created will be indicated on the screen by bold lines along the path. Pythagoras will calculate the total length of the path and the midpoint.

A path can be used for the following purposes:

- Calculation of the total length of a path,
- To obtain a cross- or longitudinal section along the path,
- To construct parallel lines / arcs to a path.

Remarks:

- *During the creation of a path, you can use the BACKSPACE key to remove the last point or last arc of the path.*
- *During the creation of a path, you may "double click" on a line or arc. Pythagoras will automatically add all lines and arcs, in the given direction, to the path up to a point where the lines stop or if a junction is encountered. If no lines follow, the path will be created. When stopped at a junction, the path is not yet created and more objects can still be added.*
- *If the X-key is down in selection mode, Pythagoras will only search for paths, and indicate the path closest to the cursor.*
- *A parallel path will be created when clicked on a path with the parallel tool.*

User Coordinate System

The toolbox item "Coordinate System" allows you to create a new Temporary coordinate system or a new User coordinate system.

You create a new User coordinate system by clicking the mouse button first on the point in the drawing, which will become the origin of the new user coordinate system, then on a point, which is on the x-axis or north-axis (depending on the selected preference).

The newly created user coordinate system will become the active user coordinate system.

Note:

- *When the CTRL key is pressed when you click on the origin of a new coordinate system, a temporary coordinate system is created. The axes of the newly created coordinate system are parallel to the axes of the active coordinate system.*
- *When the CTRL key is pressed when you click on the point indicating the origin of the new coordinate system, a temporary coordinate system is created.*
- *When a new temporary coordinate system is created, the old one is removed automatically.*

Default Attributes - Current Layer

The new objects you create interactively will get the default attributes and will be placed in the current layer.

Run Macro

This menu item is only active when a macro-library is loaded that contains valid libraries. It shows the list of all macros that are available in the current document and library.

Select

In "Select mode" you may:

- Obtain information about the basic objects on the drawing.
- Select and deselect objects.
- Drag text from one position to another.

Selection options

There are 3 ways to select objects in the 'Tools' menu ('Tools' → 'Select'):

- ***Arrow***: also has snapping capability.
- ***Cross-hair***: only allows selection of objects inside a rectangle. Snapping is not possible.
- ***Freehand***: "Lasso"-selection that allows you to draw a random area. All objects inside the area will be selected.

Obtaining Information About Objects

Points

When you move the mouse cursor near a point in the drawing, the point number and the exact coordinates of the point will be displayed in the control panel. When the point number is visible, you may be sure that Pythagoras has snapped to the point, and that the displayed coordinates are those of the given point.
If you double-click the mouse button when the cursor is on the point, the object info command (see PART II → Chapter 6: → Object Info) will be executed (its properties appear).

Lines

When you move the mouse cursor near a line in the drawing, the horizontal length of the line (L) and the identifiers of the endpoints will appear in the control panel. By using the TAB-key, the control panel will show in sequence: the slope distance (S), the height difference (dZ), the bearing (B) and the gradient (%) of the line.

Arcs

When you move the mouse cursor near an arc in the drawing, the arc length (L) and the identifiers of the endpoints will appear in the control panel. By using the TAB-key, the control panel will show subsequently the radius (R), the center angle (C) of the arc, the slope distance (S), the height difference (dZ) and the gradient (%).

Circle

When you move the mouse cursor near a circle, the control panel will show the circumference (L). By using the TAB-key, the radius (R) will be displayed.

Text

When you double click on a text a dialog box displaying the text and its attributes will appear. This way you can quickly change the text content and/or the text attributes.

Polygon

When you move the mouse near the center of gravity of a polygon, an indication (rectangle containing the letter P) will appear.
The control panel will show the area. By using the TAB-key, the control panel will show the perimeter.

Path
When you move the mouse cursor near the midpoint of a path, the control panel will show the horizontal length (L) of the path. By using the TAB-key, the control panel will show subsequently the slope distance (S), the height difference (dZ) and the gradient (%) between the first and the last point of the path.

Remark: *When specific information about an object is displayed, for example the slope distance, then you can make this type of information the default for the object type. Press the SHIFT-TAB key to change the default for an object type while the desired information is displayed. This default is not retained when leaving Pythagoras.*

Selecting Objects

When the mouse is snapped to a Pythagoras object, and you click the mouse button, the object will become selected, and all other objects will become deselected. If the object was already selected, it will be deselected.

When you keep the SHIFT-key pressed at the same time you click the mouse button, the object will be added to the selection or removed from the selection.

When you select a line or arc, the endpoints are not selected. When the CTRL-key is pressed during the selection, also the endpoints will be selected. When the CTRL-key is pressed during the selection of a polygon or path, the points, which are part of the polygon or path, are also selected.

If two lines or arcs are laying one above the other, the first click will select the object on top. If a second time is clicked on the object, the object underneath the first object will be selected.

Drag Text

When you keep the mouse button down on a text object, and then move the mouse, a rectangle indicating the position of the text will follow the movements of the mouse. Release the mouse button in order to place the text at the desired position.

If, when dragging, the CTRL or the ALT button is held down, the text will be duplicated when the mouse button is released. The new text will appear on the place where the mouse button is released.

Notes:
- *Dragging can be cancelled when you press the "Escape" key on the keyboard while you have the mouse button down.*
- *In "Select Mode", Pythagoras will continuously search for objects located near the cursor position. Since you may be interested in any object type, Pythagoras will snap to any object, which is near the mouse position. If several objects are close together, it can be difficult to select the desired object. You can either zoom in, or you can press one of the following keys to indicate in which object type you are interested:*

"P": when the P-key is down, Pythagoras will only search points.
"L": when the L-key is down, Pythagoras will only search lines, arcs and circles.
"T": when the T-key is down, Pythagoras will only search text.
"O": when the O-key is down, Pythagoras will only search polygons. In this case the snap area will become much larger.
"X": when the X-key is down, Pythagoras will only search paths. The snap area will also become much larger.
"I": when the I-key is down, Pythagoras will only search images.

Operations on Selected Objects

You can execute the following operation on selected objects:
- Delete the object: Cut and Clear command, or using the "Delete" key on the keyboard.
- Change the attributes of the objects
- Move the objects to another layer
- Move the objects

These operations are described in detail in other sections of this manual.

Align Objects

This tool ('Tools' → 'Align Object') is used to align objects. First click on the object that needs to be aligned (e.g. text, symbol). Then click on the object that indicates the direction (a line, arc, circle, text, polygon).
This tool is a more intuitive method than making use of a coordinate system to align objects.

This function can also be used to align an image to another image or text.

Join Objects

The Pythagoras Join Objects Mode allows you to extend and trim lines and arcs. This mode also allows you to project points and texts on a line, arc or circle.

When this toolbox item is selected, the cursor changes to a bold arrow.

When you first click on a point, then this point will be projected on the object (line, arc or circle) you click on next.

For extending or trimming lines and arcs, you first click on the line or arc you want to change. The cursor will now slightly change. Subsequently click on another object. This may be an arc, line or circle. When double clicking on the second object, also this object will be extended or trimmed to the point of intersection.

The line or arc you first clicked will now be extended or trimmed according to the following rules:

a) Line - Line
- The intersection is not on the line segment: the line will be extended.

- The intersection is on the line segment: the line will be trimmed. The part of the line on which the cursor was first clicked will remain. The other part will be deleted.

b) Line - Arc or Circle

- One of the endpoints on the line is an intersection: the line will be extended or trimmed relative to the second point of intersection.
- The intersection most close to one of the endpoints of the line will be the point relative to which the line will be extended or trimmed. The rules describe in section "a) Line - Line" apply.

Normally the nearest intersection point will be used to make the join. If you hold the SHIFT-key while you are clicking the arc, the other intersection point will be used.

c) Arc - Line, Arc or Circle

- The intersection(s) of the line and the arc is or are not on the arc: the arc will be extended or trimmed with the smallest possible extension.
- One of the endpoints of the arc is on the line: the arc will be extended so that both the endpoints are on the line.

Remark: The "Join objects" command also can be used to obtain the projection of points and texts on a line.

d) Align text and images

Texts and images can be given the same 0-point as another text or image using this align button.
Example:

aaaaaa becomes aaaaaa
bbbbbb bbbbbb

When holding down the CTRL-key, the alignment will be horizontal.
Example:

aaaaaa becomes aaaaaa bbbbbb
bbbbbb

Cut Object

The "Cut object" tool removes a part of an object, which is defined by two points of intersection.

Click the object to cut out. Then click the cutting edges. These can be points, lines, circles and arcs. The edges or their extension need to be on the line segment to cut off. If these are points, their perpendicular projection needs to be on the line to cut off.

If the line crosses a circle, there are two possibilities to cut off. Pythagoras considers the intersection point of the circle with the line nearest to the mouse click as the cutting edge.

Divide Object

The "Divide object" command divides a line or an arc in 2 parts. You first need to click on the object that you want to divide and then click on the object that needs to divide the first object. This can be a point, line or arc.

If the two objects cross each other, the intersection point will be the dividing point. In the other case the extension of the line will determine the dividing point.

As mentioned, points can also be dividing points, whether they are on the line or not. If they are not, a virtual perpendicular line from the point to the line to divide will determine the dividing point.

Remark:

- *A circle cannot be divided.*
- *The dividing points that will be created will be invisible, by default.*

Intersection

Selecting "Intersection" in the Tools menu allows you to create the intersection of 2 lines, a line and an arc, or 2 arcs.

When this tool is selected, the cursor changes to an "x1" symbol. You first click on a line or arc. Subsequently the cursor will change to an "x2" symbol and you click on the second line or arc. The intersection of both objects will be created.

The height of the intersection is calculated by interpolation on the second object.

If you want the intersection point to have the average height, you need to use the menu 'Calculations' → 'Intersection…'.

Extend Line

The "Extend line" command allows you to extend or shorten lines and arcs. You just need to click the object and then one of its endpoints. Then you can drag this point to extend/shorten the line.

Cut off

The "Cut off" command erases all objects - possibly including parts of images - inside or outside a rectangle. Objects on the edge will be cut off (exception: texts and symbols).

The following choices can be made:

- Vector and raster information can be cut off at the same time.
- Cut off only vector information.
- Cut off only raster information.

New Object

Symbol

Selecting 'Symbol' in the 'Tools' → 'New Object' menu allows you to draw a symbol. First you need to select the desired symbol with the menu 'Defaults' → 'Library Symbol' (or 'Document Symbol'). A symbol can be created either by entering the coordinates of the hotspot or by placing the hotspot of the symbol on a line, arc or circle.

The orientation of a symbol is defined by first moving the hotspot to a line with the desired orientation. Click the mouse button and the symbol will take the orientation of the line. Pressing the space bar will rotate the symbol over 90°.

Remark: *The program will automatically come in the mode "Draw Symbol" if you press the CTRL key while you select the symbol in the "Default" menu.*

If a symbol is placed on the drawing without giving it an orientation, and without rotating it afterwards, the symbol will be considered as an horizontal symbol, even if it is rotatable. The symbols will remain horizontal even if the drawing is rotated using "Select Print Area".

Every point can be changed to a symbol. The coordinates of the hotspot of the symbol will in that case correspond with the coordinates of the point.

Rich Text

The "Rich Text Editor" ('Tools' → 'New Object' → 'Rich Text') allows you to type texts with specific formatting. You could consider this a "dressed down" word processor. Most basic functions that you find in a word processor, you will also find here.
Most functions will not require an explanation, but we would like to point out a few handy features that will make your life (read: drawing) easier.

Quick key: click the text symbol in the control panel, while holding down the CTRL-key

When selecting this function, the cursor will change in a '+'. You can now draw the text-area by clicking and dragging a rectangular area (i.e. press and hold down the left mouse button, then drag the cursor over the screen). Depending on the direction that you drag your mouse, the window will have different characteristics with respect to alignment:

a) *Click and drag **down**:*
   The text-block will be 'top-aligned'
b) *Click and drag **up**:*
   The text-block will be 'bottom-aligned'
c) *Click and drag **to the right:***
   The text-block will be 'left-aligned'
d) *Click and drag **to the left**:*
   The text-block will be 'right-aligned'

Note:

- *To align a text block "centered", you can make use of the menu option 'Format' → 'Alignment' → 'Center'.*

- *Aligning the text block is independent of the alignment of the content. For example, in a left-aligned text block, you can place centered or right-aligned text.*

Examples:
1) When clicking and dragging the cursor from top-left to bottom-right, you created a text block that is top-aligned, and left-aligned.
2) When clicking and dragging the cursor from bottom-right to top-left, you created a text block that is bottom-aligned and right-aligned.

Example 1 is useful if you want to place text in the top-left corner: the text 'grows' in a downward direction, while alignment remains left.
Example 2 is useful if you want to place text in the bottom-right corner of the page: the text 'grows' - if need be - in height, while the alignment remains right.

The width of the text blocks can always be changed by clicking and dragging the solid line (widening or narrowing the text field). For left-aligned text, this line is located at the right side of the text block. For right aligned texts, the line is located at the left side of the text block.

While typing in the editor, you can format the text. When the text editor is active, the menus also changed. The two most important menus are 'Edit' and 'Format'.

Edit:
This menu contains the obvious edit functions such as undo and redo, cut and past, etc. The items 'Find' and 'Replace' are worth a little explanation:
a) *Find*: This function searched for a string (a word or a group of words).
b) *Replace*: This function searches for a string (a word or a group of words) and replaces these by the string in the 'replace' field.

There are additional find and replace options:
- *Entire word only*: will only search the entire word. If this is not checked, the editor will also search for the string in parts of words.
- *Case sensitive*: if this is turned off, the editor will search for the string exactly as it is, taking into account capital letters.
- *Search backwards*: searches the document backwards.
- *Wrap around search*: at the end of the document, the editor will start again at the beginning.

Format:
This menu is primarily used for formatting texts. Most functions are obvious.

'Text *Attributes…'* pops up a dialog box in which most formatting functions appear. This allows you to format the text using one menu selection.

"Line spacing" is used to set the distance between the different lines in the text. Line spacing works for each paragraph.

"*Alignment"* determines the position of the text in the text block.
- Left: the text is left aligned.
- Right: the text is right aligned.
- Center: the text is centered.

This alignment works for each paragraph.

Paragraph: in a Pythagoras "Rich Text" you can use the "Return-(or Enter-)" key to start a new paragraph.

Aligned Rich Text

This function ('Tools' → 'New Object' → 'Aligned Rich Text') is used to give a Rich text block the same rotation as a line.
Refer to the section above for more information on Rich Text.

Curve

Curves (splines) are created with the "curve" tool ('Tools' → 'New Object' → 'Curve'). With at least 3 points a curve shaped structure will be created. The points where the curve needs to run through need to be selected by clicking on them. To obtain a closed curve, click as last point on the first point again. If the curve needs to remain open, click the last point while holding the "CTRL" key down.

The adjustable curvature determines the shape and the size of the radii. The higher the curvature, the softer and smoother the changeover between partial arcs will be. The checkbox "100% smoothed" handles a special case: if the first part contains three linear points and the curve is forced to be straight, a sharp changeover to a curve structure is obtained. With "100% smoothed", which is activated by default, such a sharp (sudden) changeover is avoided and, in extreme cases, a course of arcs is forced.

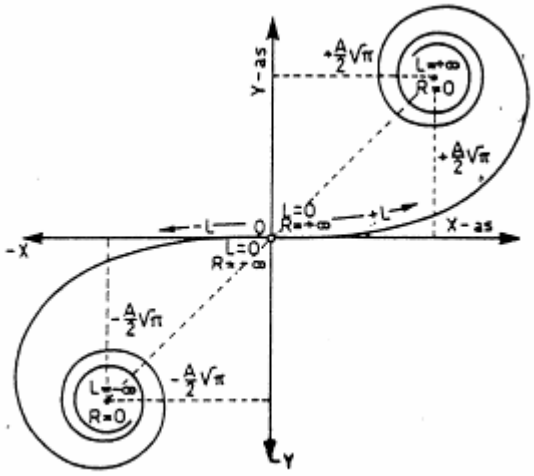
Points, which are necessary for the creation of curves, can vary in height. This results in a three-dimensional curve.

Curves (splines) can now also have a library line style assigned to them.

Spiral

With this tool ('Tools' → 'New Object' → 'Spiral') it is possible to create spirals. A spiral is a transition curve whereby the curvature proportionally increases or decreases with the cumulated distance, i.e. if a vehicle with uniform speed drives through a spiral, the speed of the rotation of the steering wheel is a constant.

A spiral in Pythagoras is limited to a change of angle of 100gon (see picture below).



A spiral is represented by the following formula:

$$R*L = K^2$$

With: K: parameter of the spiral
R: radius of curvature
L: length of a part of the spiral measured from the point with R = ∞

A spiral can be constructed in 4 ways:

1. Insert an existing spiral.

   Note: The accuracy of the entered data needs to be at least the same as the number of decimals in the control panel.

2. With a beginning and an end point
   a. Parallel to a line: defined by beginning and end point.
      The beginning point has a R = ∞. The 'K' value or the 'R2' (= radius of the tangent circle in the end point) can be entered

   b. Tangent starting from a specific point on an existing circle/arc.
      The spiral will start with the R of the arc or circle and will be constructed till a R = ∞. The mouse movements can influence the end tangent direction. This also goes for R < R circle. This just hasn't so many results.

   c. Tangent starting from a specific point on a spiral.
      The spiral starts with the radius of the starting point on the spiral and will be made to R = ∞. This also goes for R < R spiral. This just hasn't so many results.

3. Between existing objects:
   a. Between an existing line and circle/arc
   b. Between two circles/arcs
      this is only possible when the circle with the smallest radius is inside the one with the largest radius and with very little deviations.

4. Arc tangent to 2 lines with 2 spirals.

Almost all operations can be applied on spirals.

Edit Line

The following modifications can be made to lines ('Tools' → 'Edit Line'):

- Join.
- Cut Object.
- Divide Object.
- Intersection.
- Extent line.

All these modifications were described above for "Drawing Tools" tool panel.

Edit Curve

The following modifications can be made to curves (splines) ('Tools' → 'Edit Curve'):

- ***Move Point***: move the cursor to the point that you would like to move. The cursor will change into a little cross. Move the point by clicking and dragging it. If point confirmation has been turned on, you will be able to enter the exact new coordinates of the point.

- ***Add Point***: move the cursor to a place on the curve where you would like to add a point. The cursor will change into a little cross. Click and drag the curve to the new position (may, but must not be an existing point). Confirm the new coordinates. If the new point was an already existing point, you will notice that the cursor can snap to the point.

- ***Remove Point***: move the cursor to the curve and click the curve. Little circles will indicate the points of the curve. Click the points that you would like to remove from the curve.

Edit Polygon

The same modifications as those on curves can be performed on polygons ('Tools' → 'Edit Polygon').

Edit Path

The same modifications as those on polygons can be performed on paths ('Tools' → 'Edit Path'), with one exception: moving points. If you would like to move points of a path, we recommend that you use the traditional move function ('Edit' → 'Move').

Edit Group

This command ('Tools' → 'Edit Group') allows you to add/delete elements to/from a group. When you choose this menu item and put the cursor over a group, it will indicate that a valid group is found by changing to a special cursor . After selecting the group, you can choose the elements to add or delete from it.

DTM

This command ('Tools' → 'DTM') allows you to modify the active DTM. The following operations are possible:

- Swap diagonal
- Delete a triangle
- Delete a point
- Add a point
- Move a triangle vertex
- Change the elevation of a triangle vertex

These tools are only enabled if the triangulation is visible. The intensity of the objects of the drawing will be reduced. The areas of the triangles will be hatched in a light green color.

Note:

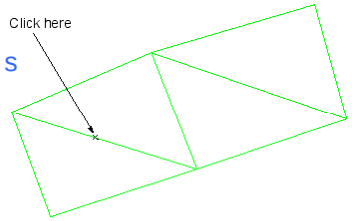
- *Operations on a DTM cannot be undone. It is recommended to make a backup of the drawing or DTM before editing the DTM.*
- *Operations on a DTM don't change the points or other objects that were used to create the DTM. Only the DTM is changed.*

Swap Diagonal

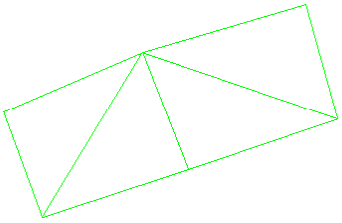
Use this option ('Tools' → 'DTM' → 'Swap Diagonal') to replace 2 adjacent triangles by 2 triangles in the same quadrangle using the alternative diagonal.

When this tool is selected, the cursor will snap to legs of triangles, except for the legs that are at the border of the DTM. When you click the mouse button, Pythagoras will replace the 2 adjacent triangles of the leg with 2 other triangles that use the other diagonal of the quadrangle formed by the 2 original triangles.

Example:



Result:



Delete Triangle

This option ('Tools' → 'DTM' → 'Delete Triangle') removes the selected triangle from active DTM.

When this tool is selected, and the cursor is moved inside a triangle, then the triangle will be marked. When you click the mouse, the triangle will be removed from the DTM.

The area of the triangle will flash for about 0.5 seconds to indicate that it will be removed. Triangle legs will be removed, unless a leg is still used by an adjacent triangle.

Move Vertex

This option ('Tools' → 'DTM' → 'Move Vertex') allows you to move vertexes of the DTM.

When this tool is selected, the cursor will snap to vertexes of triangles. You can drag a point and enter the coordinates in the control panel. A point may not be moved outside the polygon of the triangles that have the same vertex.

Note *The resulting triangulation will **not** be made "Delaunay". If you do not like the resulting triangulation, you can use any of the other functions to adjust the result.*

Add Vertex

This option ('Tools' → 'DTM' → 'Add Vertex') adds a vertex to the DTM. The cursor will snap to points in the drawing.

When this tool is selected, the cursor will snap to triangles and to points in a drawing. When you move the cursor over a triangle it will be marked. On mouse down, the x, y and z of the new point must be entered in the control panel unless at the same time the cursor had snapped a point in the drawing. The triangle to which the point was added will be replaced by 3 triangles.

Note: *The new point does not necessary have to lie in a definite triangle, it can also be placed outside the DTM. In this case, of course, the number of new triangles can be different.*

Delete Vertex

This option ('Tools' → 'DTM' → 'Delete Vertex') removes a vertex from the DTM.

When this tool is selected, the cursor will snap to vertexes of triangles. On mouse down, all triangles that have this vertex will be removed. The resulting polygon will be Delaunay-triangulated (imagine, for instance, that you delete the top of an N-angle pyramid).

Change Elevation

This option ('Tools' → 'DTM' → 'Change elevation') allows changing elevation of the selected vertex of DTM.

When this tool is selected, the cursor will snap to vertexes of triangles. After clicking on a point you have to enter the new elevation in the control panel.

Lasso

This command ('Tools' → 'Lasso') allows you to modify (make black or white) partial areas of a raster image.
This operation will not be saved in the image itself, but in the Pythagoras drawing with a reference to the image.

Eraser

This command ('Tools' → 'Eraser') allows you to "erase" parts of a raster image or to make these parts black.
This operation will not be saved in the image itself, but in the Pythagoras drawing with a reference to the image.

Dimension

The toolbox item "Dimension" ('Tools' → 'Dimension') allows you to create/place dimensions (line lengths), areas and coordinates on the drawing.

Creating a measurement creates a text object with the value of the measurement. Like any other text object, you can change the content and the attributes of a measurement. There remains no link between the object of which the dimension is requested and the text object containing the measurement.

When you request a measurement, and Pythagoras finds a text object at exactly the same position, the new text will not be created.

The XY-Offset dimensioning will place the x and y offsets of a point on the drawing relative to the active coordinate system. Also the baseline and the perpendicular line to it will be constructed.

When you select XY-Offset in the toolbox, and keep the CTRL-key down while you click on a point, you will automatically come in the mode to create a coordinate system. Clicking subsequently on the first and second point, which indicates the baseline for dimensioning, Pythagoras will automatically create a temporary coordinate system.

Remark: You may obtain the XY-Offset dimensioning of a number of selected points in one operation. Select the menu "Format", "Operation", "Annotation", "XY-Offset".

Lines

When you click the mouse button when the cursor is near a line, an object text, containing the length of the line will be created on the drawing.
Defaults ('Defaults' → 'Preferences…') regarding the representation of line lengths are:

- text point size;
- text weight;
- number of decimal places;
- measurement pre-string and post-string.

The pre-strings and post-strings are optional characters which can be set in front and after the value calculated by Pythagoras (using 'Defaults' → 'Preferences…'). For example if the pre string = "-" and the post string = " m.-", then the value 12.50 will be represented as: "-12.50 m.-". The pre-strings and post-strings can be set to empty values.

The line length will always be centered relative to the center of the line.

Polygon: Area and Perimeter

When you click the mouse button when the cursor is near the center of gravity of a polygon, the line lengths of the perimeter and the area of the polygon will be created on the drawing. The length of the lines have the same defaults as those for single lines (see above).

Defaults ('Defaults' → 'Preferences…') regarding the representation of the area are:

- text point size;
- text weight;
- number of decimal places;
- a pre-string and a post-string.

A title text is created by Pythagoras to bring the area of a polygon on the drawing. The position will be the center of gravity of the polygon, and the text will be centered.

Annotation

The toolbox item "Annotation" ('Tools' → 'Annotation') allows you to create annotations belonging to polygons and points.

Polygon annotations include:

- Perimeter
- Area
- Comment (information linked with the polygon).

Annotations for lines and paths:

- The horizontal length.
- The slope length.
- The difference in elevation between the end points.
- The gradient.
- The bearing (only for lines).

The menu item "Horizontal length" can also be used to annotate the horizontal distance between two points that are not connected to one another with a line, or to annotate the perpendicular distance between a point and a line.

All elements of a path will be annotated in one operation.

Point annotations include:

- Point number.
- The elevation of the point.
- Information linked with the point.
- The coordinates of the point.

Arcs and circles can have the radius and the center angle.

With the exception of "Comment" all other annotations can also be created using the tool "Dimension". In contrast with "Dimension", the items are not grouped but create individual text objects.

Create Viewport

Creating a Viewport ('Tools' → 'Create Viewport') allows you to copy a part of the drawing in the same or in a different scale.

To create a Viewport, select the menu option ('Tools' → 'Create Viewport'), and then click and drag a rectangle over the area that you would like to appear in the Viewport.

By moving the cursor to the center of the Viewport, a cross appears, and the Viewport can be clicked and dragged elsewhere on the drawing. Clicking and dragging (the little hand) elsewhere in the Viewport, allows you to "pan" inside the Viewport.

Zooming in and out can be done using the zoom function or by holding down the CTRL-key while scrolling with the mouse button.
The size of the Viewport can be changed by clicking and dragging the border or corners of the Viewport.

Right-clicking on the Viewport and selecting Properties, allows you to change certain properties, such as the scale, the shape of the viewport (rectangle or ellipse), whether you would like the border of the viewport to be visible or not, or whether you would like a different View to apply to this Viewport (a different view than the main drawing View).

Private Tool

This is a part of VBA.
A private tool ('Tools' → 'Private Tool') allows the user to send mouse-actions to macros (also referred to as Event-macros). These macros can then perform a certain function.
When Pythagoras is in "Private Tool" mode, it will search for "event macros" and execute them immediately.

For more details, please refer to the "Pythagoras VBA manual" (you can find it on www.pythagoras.net in "Downloads → Product Manual" section).

Chapter 4: The Format Menu

The 'Format' menu contains commands acting on selected objects. Commands in the 'Format' menu will be enabled when one or more objects of the corresponding type are selected.

Attributes

Copy

A selection of objects can easily be modified into a specific "look". All you need to do is select an object, then select "copy" in this menu ('Format' → 'Attributes' → 'Copy'). The attributes (properties) of the selected object will then be applied as the currently active attributes.

Paste

Using this menu option ('Format' → 'Attributes' → 'Paste'), the attributes that are currently active will be pasted to (applied to) the selected objects.

Note: These copy & paste commands can also be accessed by clicking the right mouse button.

[List of User Defaults]

You can also apply User Default attributes to objects that are already in the drawing. All you need to do is select the objects, then select the appropriate User Default in this menu ('Format' → 'Attributes' → User Default). All selected objects will change their "look" and will receive the attributes of the chosen User Default.

Data

Copy

Database information linked to a selected object can also be copied into other objects. All you need to do is select an object, and then select "copy" in this menu ('Format' → 'Data' → 'Copy').

Paste

Using this menu option ('Format' → 'Data' → 'Paste'), the database information that has been copied to the clipboard will be pasted to the selected objects.

Note: These copy & paste commands are also accessible by clicking the right mouse button.

Point Style

The 'Point Style' command ('Format' → 'Point Style') changes the style of the selected points to one of the following point styles:

- Hidden: a point will be visible on the screen, but it will not be printed or plotted.
- Cross (+),
- X Cross (x),
- Slash (/),
- Round Dot,
- Round Dot hollow,
- Rectangle Dot,
- Rectangle Dot hollow,
- Triangle;

- Hotspot (used in Symbol creation),
- Reference Point (used in Road design - typical sections),
- Split Point (used in Road design - typical sections).

Library Symbol

This command ('Format' → 'Library Symbol') allows you to choose a symbol from an existing library as a new style for the selected point.

Document Symbol

This command ('Format' → 'Document Symbol') allows you to choose a document symbol as a new style for the selected point.

Line Style

The 'Line Style' command ('Format' → 'Line Style') changes the style of the selected lines to one of the following lines styles:

- Solid,
- Dash,
- Dot,
- Dash Dot,
- Dash Dot Dot.

Library Line Style

This command (‘Format’ → ‘Library Line Style’) allows you to choose a line style for the selected lines from an existing library.

Document Line Style

This command (‘Format’ → ‘Document Line Style’) allows you to choose a document line style for the selected lines.

Line Width

The 'Line Width' command ('Format' → 'Line Width') changes the width of the selected lines.

A number of values are proposed in the menus, but any value can be entered manually in the entry field, ranging from 0.01 mm to 2.55 mm, in increments of 0.01 mm.

Line Arrows

When you want to create lines or arcs with arrows at the endpoints, you select 'Line Arrows' in the menu 'Defaults'. New constructed lines and arcs will have arrows at the endpoints. You can suppress an arrow at one or both endpoints if you keep the SHIFT key pressed while you confirm the concerning point.

To draw lines without arrows, you need to reset 'Line Arrows' in the menu 'Defaults'.
To add or delete arrows on an existing line, select the line and the endpoint(s) that you want to change. Then, select 'On' or 'Off' in the menu 'Format' → 'Line Arrows'. You can only change the line arrows if you also select the endpoints of the line.

Note: Pressing the SHIFT-key when you confirm the second point of a line or arc, will start a new line or arc. This can be very practical if you want to draw a series of connected lines or arcs, with only arrows at the starting point and at the endpoint of the polyline. If you want to draw a single line (arc) with one arrow, start at the end without arrow, while holding down the SHIFT-key and release the SHIFT-key while confirming the other end.

Curvature

With this command ('Format' → 'Curvature') you set the curvature of the curve. The smooth factor can be set from 0 to 10. A curvature of 0 results in straight lines. A curvature of 5 comes close to circular arcs.

Text: Attributes

With the "Text Attributes" command ('Format' → 'Text Attributes…') you can change one or more text attributes:

- Font: the font currently used.
- Horizontal alignment: left, centered, right.
- Vertical alignment: top, centered, bottom.
- Point size: from 4 up to 1000 points.
- Style: normal or italic.
- Weight: light, medium, bold, extra bold.
  If you work with a high resolution printer, these differences in weight will be noticeable. In case you work with a pen plotter, the result will depend on what quality of pens you use.
  We advise you to make a printing of text in different sizes and weights. You can use this overview when you make your selections during drawing.
- Underline: none, single, double, dashed.
- Border: none, single, double.
- Line spacing: small, normal, large.
- Opaque (i.e. non-transparent): yes or no.
  This way, objects, which are under texts, can be hidden. When you use different display levels, an object that is underneath another can be transparent. So you can totally hide these objects.
- Orientation: horizontal, readable, absolute angle.

The text attributes apply to both regular text and rich text.

Text: Content

This menu ('Format' → 'Text Content…') item allows you to change the content of selected texts into a new text. This new text can be typed as usual, or may be selected from a list of pre-defined texts. To pre-define texts, refer to this topic further in this manual.

Polygon Pattern

The 'Polygon Pattern' command ('Format' → 'Polygon Pattern') changes the fill pattern of a polygon to one of the following fill patterns:

- no fill pattern,
- horizontal pattern,
- vertical pattern,
- diagonal pattern (upward direction),
- diagonal pattern (downward direction),
- cross pattern,

- single boundary,
- double boundary,
- single boundary (open),
- double boundary (open),

- 100% (black),
- 75% (dark gray),
- 50% (gray),
- 25% (light gray),
- 12% (very light gray).

When a new polygon is created it will have no fill pattern.

Library Pattern

This command (‘Format’ → ‘Library Pattern’) allows you to choose a pattern for the selected polygons from an existing library.

Document Pattern

This command (‘Format’ → ‘Document Pattern’) allows you to choose a document pattern for the selected polygons.

Polygon

With this command ('Format' → 'Polygon…') you can change the specific properties (pattern, border, etc.) of the selected polygons.

Note: Double clicking on a polygon allows you to you change more properties (layer, color, etc.)

Scale

Symbol

The 'Format' → 'Scale' → 'Symbol…' command allows you to scale a symbol in the x- and y-direction. Negative values can be entered to mirror the symbol.

The value entered is an absolute value, unless you check the "Relative scale" option. This makes sure that the symbols enlarge or shrink by a specific percentage in reference to their current size, and not in reference to their original size.

Text

The 'Format' → 'Scale' → 'Text…' command scales the text of the selected objects. When the Scale Text command is selected, a dialog box will appear requesting the scale factor. The scale factor is a percentage of the actual point size.
When a factor smaller than 100 is entered, the point size of the selected text will be reduced. When a factor greater than 100 is entered, the point size of the selected text will be enlarged. For example: factor = 200, point sizes will be doubled.

Note: The scaled point sizes will remain between 4 point and 1000 point, and the values will be rounded to valid integer values. So rescaling of text does not necessarily reproduce the same point sizes.

Scaling of all text of the drawing or portions of it is useful when you want to make a copy of your original drawing on a different scale.

Image

The 'Format' → 'Scale' → 'Image…' command can be used to scale an image. For more information see PART II → Chapter 1: → Import: Image.
The value entered is an absolute value, unless you check the "Relative scale" option. This makes sure that the images enlarge or shrink by a specific percentage in reference to their current size, and not in reference to their original size.

Line

Using the 'Format' → 'Scale' → 'Line…' command you can scale the pattern of the selected line. This way you can make the patterns of your line visible when a line is too short by reducing the scale factor from e.g. 100% to 25%.
The value entered is an absolute value, unless you check the "Relative scale" option. This makes sure that the line styles enlarge or shrink by a specific percentage in reference to their current size, and not in reference to their original size.

Polygon Pattern

With the 'Format' → 'Scale' → 'Pattern…' command you can scale a pattern.
The value entered is an absolute value, unless you check the "Relative scale" option. This makes sure that the patterns enlarge or shrink by a specific percentage in reference to their current size, and not in reference to their original size.

Align

Pattern

The fill pattern of selected polygons can be aligned according the active user coordinate system ('Format' → 'Align' → 'Pattern').

The fill pattern will be aligned with the direction of the active user coordinate system. The origin of the fill pattern will correspond with the origin of the coordinate system.

Note: Only polygons with user defined patterns can be aligned.

Text

The 'Format' → 'Align' → 'Text' command aligns the selected text according to the active user coordinate system

Symbol

The 'Format' → 'Align' → 'Symbol' command aligns the selected text according to the active user coordinate system

Note: this operation is only possible if the symbol had the rotatable characteristic set when creating it.

Image

Using the menu option 'Format' → 'Align' → 'Image' you can align the selected images in reference to the active coordinate system.

Layer

The 'Layer' command ('Format' → 'Layer…') moves the selected objects to the indicated layer.

Display Level

With the 'Display Level…' command ('Format' → 'Display Level…') you can set the selected objects to a specific display level or increase or decrease the actual level by a specific value, so that the mutual relation is maintained.

Color

The 'Color' command ('Format' → 'Color') will change the color of all selected objects to the indicated color. You can either select colors from the color chart that pops up, enter the corresponding color number, enter the RGB (Red, Green, Blue) value of the color, or enter the HSL (Hue, Saturation, Luminance) value of the color.

Operation

Renumber Points

You have 3 choices ('Format' → 'Operation' → 'Renumber Points…'):

- Renumbering of points starting from a given number. If renumbering would create points with an existing number, a warning message is given. Then renumbering can be either aborted or continued.
  When one or more polygons are selected, the points making up the polygon will also be renumbered. However, their sequence will not be random, but the numbering will be in ascending order in the same sequence as the points appear in the polygon.

- Clear point numbers. The point numbers of the selected points will be removed.

- Increment (numeric) point numbers. The existing point numbers will be incremented by the given value.

Coordinate List

A list of the coordinates (in the active coordinate system) will be created in Page Coordinates in the bottom-right corner of the page after you select 'Format' → 'Operation' → 'Coordinate List'. The appearance and the attributes of the Coordinate List can be set with the dialog box "Preferences" ('Defaults' → 'Preferences…' → 'Annotation' → 'Coordinates').

The Coordinate list can be edited in Pythagoras using the Rich text editor. In addition, it has a table format and can be copy-pasted into any spreadsheet and/or word-processing program.

Polygon List

A list of the selected polygons will be created in Page Coordinates in the bottom-right corner of the page after selecting Format' → 'Operation' → 'Polygon List'. This list contains the description (the object comment) of each polygon, and its area. The units and attributes of the Polygon List can be set with the dialog box "Preferences".

The Polygon list can be edited in Pythagoras using the Rich text editor. In addition, it has a table format and can be copy-pasted into any spreadsheet and/or word-processing program.

Adjust Elevation

Selecting this menu item ('Format' → 'Operation' → 'Adjust Elevation…') will change the elevation of all selected points. Depending on the selection you make in the dialog box, the points will either get a fixed elevation (Z) or the elevation will be adapted with the value entered (dZ).

Change Comment

Selecting this menu item ('Format' → 'Operation' → 'Change comment…') will display a dialog box, allowing you to enter new object information. All selected objects will get this comment.

Annotation

This menu option ('Format' → 'Operation' → 'Annotation') annotates the **selected objects**.

Chapter 5: The Defaults Menu

The defaults menu allows you to change defaults used by other Pythagoras commands.

Snap

This menu ('Defaults' → 'Snap') is used to determine the behavior of the cursor in Pythagoras.

By default, Pythagoras will snap to any object. Using this menu, you can turn on or off snapping to specific objects.

User Defaults

This menu ('Defaults' → 'User default') allows you to select either the standard defaults (None), or one of your user defaults. A user default may overwrite one or more attributes of the standard defaults.
The creation of User Defaults is described further in this chapter, see Defaults: User Defaults Manager below.

Point Style - Line Style - Line Width – Line Arrows

The above commands change the default settings of the point, line and text attributes.

These defaults will be used when a new point or line is created using the 'Tools' commands.

Library Symbols / Line Style - Document Symbols / Line Style

These menu items allow you to select the default point symbol and line style from the document or library.

Text

The above command ('Defaults' → 'Text…') changes the default settings of the text attributes.

An exception is the "Annotation" command ('Tools' → 'Annotation'). The default text attributes of text created by the "Measurement" command

('Tools' → 'Dimension') will depend on the defaults set with the Preferences command ('Defaults' → 'Preferences…').

Polygon

With this command ('Defaults' → 'Polygon…') you can change the defaults of the polygon properties.

Display Level

The default level for new objects can be set with this command ('Defaults' → 'Display Level'). You can set this value from –10 to 10.

Color

This command ('Defaults' → 'Color') allows you to change the default color. All new objects created interactively will obtain the default color.
You can either select colors from the color chart that pops up, enter the corresponding color number, enter the RGB (Red, Green, Blue) value of the color, or enter the HSL (Hue, Saturation, Luminance) value of the color.

Defaults

User Defaults Manager

A "User Default" ('Defaults' → 'Defaults' → 'User Default Manager…') specifies attributes for objects (points, lines, color, layer, etc.), which overwrite the standard defaults when the User Default is selected.
You may define up to 256 user defaults.

In the dialog box "User Default Manager" you may create a new default by entering a name and click on the "New" button. Next you define e.g. the point, line, text and polygon attributes. When no value for an attribute is given, the standard default will be used. Entering a value for an attribute will disable the standard value (menu "Defaults").

[List of User Defaults]

You can also apply an existing User Default by selecting it from the list in this menu ('Defaults' → 'Defaults' → User Default).

Note: This function can also be accessed by clicking the right mouse button.

Restore

You may return any time to the start-up defaults by selecting "Restore" ('Defaults' → 'Defaults' → 'Restore').

Save

During the start up Pythagoras, the following default attributes will be initialized:

- Point style,
- Symbol,
- Line attributes (style, width, etc.),
- Text attributes (size, style, position),
- Color.

These default values are saved in the file PYTHAGOR.DEF.
When you want other start-up defaults, you first set all attributes in the menu 'Defaults' to your preferred value, and subsequently you select 'Save' ('Defaults' → 'Defaults' → 'Save').

Document Defaults

Confirm Operation

When creating new objects and "Confirm Operation" ('Defaults' → 'Documents Defaults' → 'Confirm Operation') is "On", Pythagoras will prompt you to provide location information (coordinates, distance, line length) in the control panel. When you are creating a survey drawing, "Confirm Operation" will normally be set "On".
When the exact dimensions are not important, drawing can be faster when "Confirm Operation" is turned "Off".
You can also turn "On" or "Off" "Confirm Operation", simply by clicking the OK button: becomes and means "Confirm Operation" off.

Scale of Page Coordinate System

The command "Scale of Page CS…" ('Defaults' → 'Documents Defaults' → 'Scale of Page CS…') will change the scale of the page coordinate system. When the page coordinate system is active, all dimensions will be calculated based on the actual scale. The actual scale appears in the control panel.

Next Point Number

The "Next Point Number…" ('Defaults' → 'Documents Defaults' → 'Next Point Number…') command changes the value used by Pythagoras when assigning a new point number.
For every new point created interactively, Pythagoras assigns a point number. This is by default a numerical value, which is increased incrementally each time a new point is created.

The new point number applies for the active drawing. When a drawing is saved, the sequence number is stored in the drawing data and will be restored when you reopen the drawing at a later time.

Incrementing the point number can be done alphabetically and numerically, and also combining both:

- Only numeric: 100, 101, 102, ...
- Starting with letter(s): ST1, ST2, ST3, ...
- Ending letters: SA, SB, SC, ...
- Letters, Digits, letters: REF15PNT, REF16PNT, REF17PNT, ...
- Digits preceded by zero: 0010, 0011, 0012, S001, S002...

Pythagoras is giving an overview of the free (ranges of) point numbers in the active drawing.

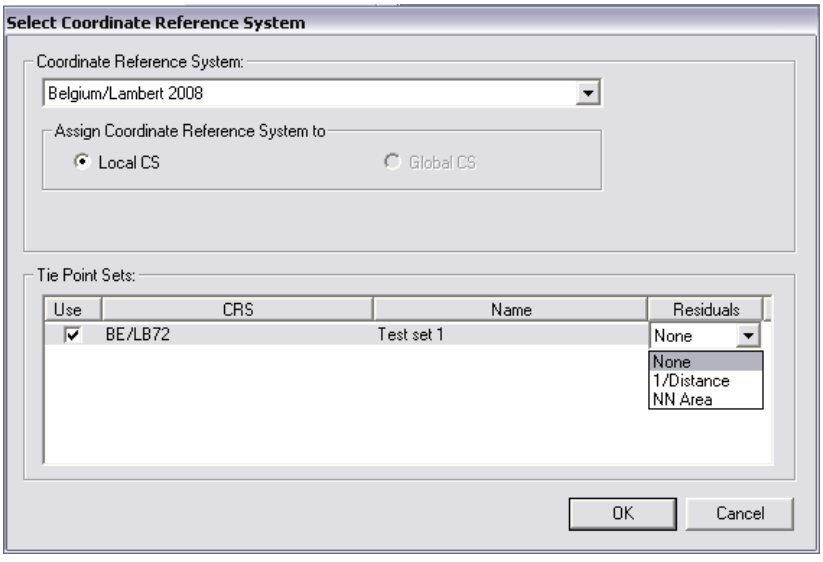
Bearing of the Drawing

This ('Defaults' → 'Documents Defaults' → 'Bearing of the Drawing') allows you to enter an absolute orientation for the drawing (corresponding to the local north).

Set Coordinate Reference System

Menu 'Defaults' → 'Documents Defaults' → 'Set Coordinate Reference System…' or -icon lets you choose CRS you want to set for your drawing.

By selecting a Coordinate Reference System from the list you give a certain meaning to the coordinates in your drawing. Those can be either Local or Global coordinates.



In the lower table you can choose a tie points set for coordinates transformation, provided you imported any tie points sets in the Pythagoras library (see PART II → Chapter 1: → Tie Points). The table will list all tie points sets where the first coordinate (in our case Lambert 2008) corresponds to the CRS of the drawing.

If there is more than one set, you can choose the appropriate one in the 'Name' combobox by double-clicking into it.

Only the tie points set which is check marked in the first 'Use' column will be used for coordinate transformations in the drawing.

For every transformation you can choose the desired residual handling:

- None or no smoothing residuals
- $1/s^2$: Inverse Distance Weighting method
- NN Area: Natural Neighbours by area method

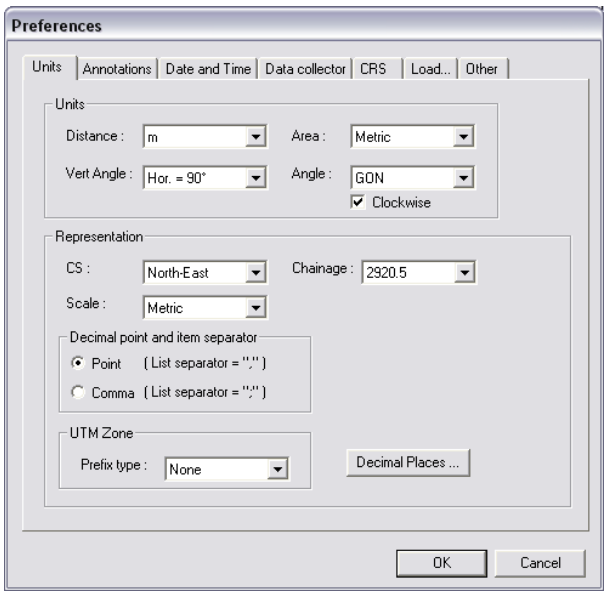
Preferences

The 'Preferences' command ('Defaults' → 'Preferences…') allows you to change the preferences for:

- Units
- Representation of annotations
- Date & Time conventions
- Data collector settings
- Coordinate reference systems
- Load texts and conversion tables
- etc.

The Preferences dialog consists of 7 tabs with different sets of parameters, which are described below more detailed.

Units

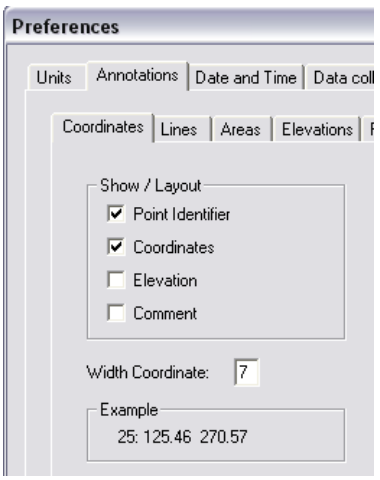


Following unit settings can be defined:

- unit of length: km, m, cm, mm, feet, US feet and miles;
- area measuring system: metric, acres, ha a ca;
- unit of angle: gon, degrees, radians, decimal degrees, MIL & surveyor;
- positive angle direction: clockwise, anti-clockwise;
- North-East or XY coordinates;
- decimal sign: "," or ".";
- number of decimal places used to represent coordinates, and dimensions (line lengths, areas in the dialog boxes (including the control panel), the drawing and in exported files);
- UTM zone prefix type.

*Note: In the control panel WGS84 coordinates are **always** displayed either in DEC (degrees decimal), or DMS (Degrees, minutes, seconds). They are never displayed in GON, RAD or MIL, so if you choose one of these three units in the Preferences, the WGS84 coordinates will be displayed in DEC. If you choose Surveyor, they will be displayed in DMS.*

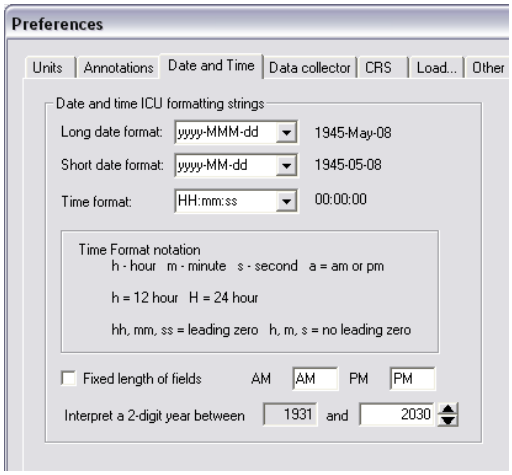
Annotations



You can determine which annotations should be shown and what should be their layout for the following items:

- Coordinates
- Lines
- Areas
- Elevations
- Point IDs
- Comments
- XY Dimensions

Date and Time



This tab determines the Data & Time ICU formatting strings:

- Long and short date formats
- Time format
- Field length
- 2-digit year notation

More about the ICU date&time standard you can find here: http://userguide.icu-project.org/formatparse/datetime.
Pythagoras supports formatting of the following items:

- y, M (except MMMMM), d, E (except EEEEE);
- a, h, H, m, s, S;
- unquoted text, text in quotes.

Please pay special attention to the “Fixed length of fields” option. If it is checked, this means that every item contains exactly as many characters as is determined by the format above.

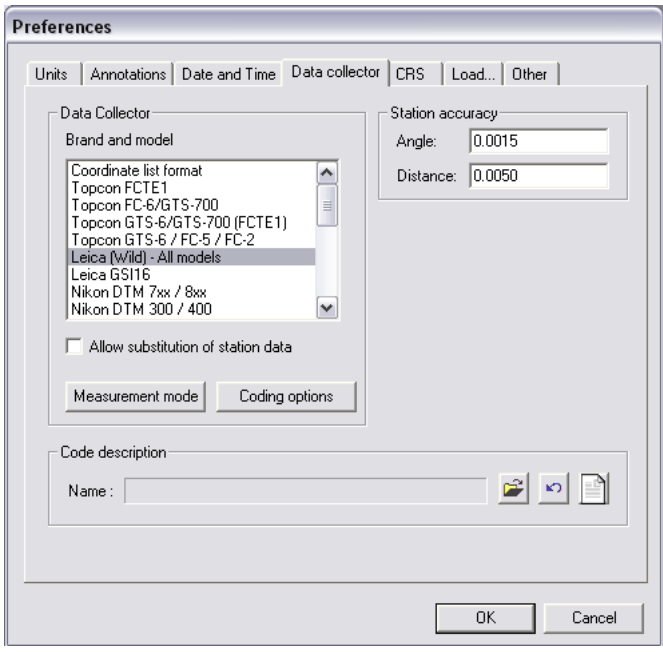
For example, we chose the ICU format yyyyMMdd. The current date is written as 20100214. When decoding this string, Pythagoras cannot determine whether it is 14-Feb-2010 or 2-Oct-20 with two spare digits. If the fixed length option is true, this date can be only interpreted as 14-Feb-2010, but the following string 100214 would be wrong – it contains not enough digits.

“Fixed length of fields” option is not part of the ICU standard, because ICU defines only the rules to encode date/time strings, but not to decode them.

Data Collector

The following instruments can be selected:

- Coordinate list format,
- Topcon FCTE1, FC-6/GTS-700, GTS-6/GTS-700 (FCTE1), GTS-6/FC-5/FC-2.
- Leica all models (including Leica 16-format).
  Partial import of a file is possible because with "File"-"Import"-"Data collector" you have the possibility to insert a from/to point number option.
- Sokkia SDR22/24/26, SDR33, Powerset and SET 2C/3C/4C.
  The order of the coordinates (NE or XY) for the SDR20 series and the SDR33 in the stakeout list will depend on the default setting in Pythagoras at the moment of export.
- Zeiss Rec500 / Rec Elta, Elta 40R/50R and M5.
- Nikon DTM 300/400 and 700/800 series.
- Geodimeter.



- Pentax R100/R300, Pentax PCS, Pentax ATSTOPO and Pentax Powertopo.
- Trimble.
- TDS 48.
- 3Ta5.

Also you can define the 'Measurement Mode' and the 'Coding Options' for the data collector.

Station Accuracy

This section allows you to set the accuracy of your total station. This value will be used by the traverse calculations (see 'Traverse' command), to check if the errors are within the allowable limits.

The accuracy for both the distance measurements and for angle measurements may be entered. These values are given in the data sheets of the total station you use.
Angle measurements: 20 cc = 0.002 GON

Code Description

A separate manual describes the Code Description File ("Pythagoras Coding Manual", which you can find at www.pythagoras.net). This file defines the codes, which may be used in a data collector file, their meaning (line, point, symbol, etc.), and the attributes used by Pythagoras to generate a drawing.

CRS

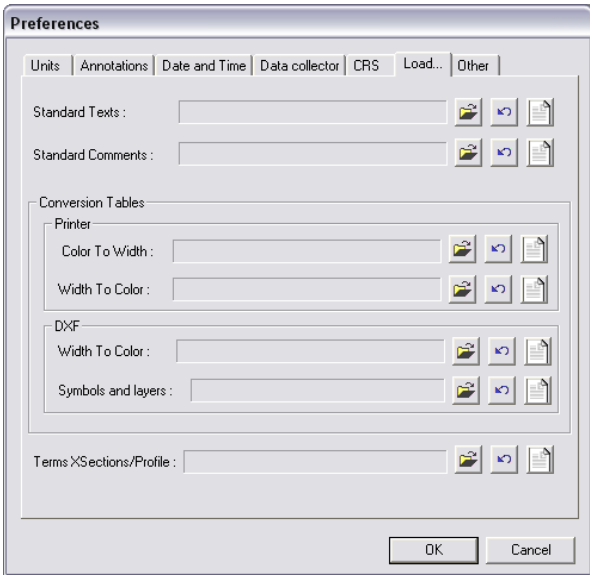
This tab lets you determines the list of Coordinate reference systems which you want to view in your drawing.

Load...

In this tab you can load standard texts, comments, conversion tables, and terms cross-sections and profile.

Standard Texts/ Comments

You can enter often-used texts or comments in a text-file (ASCII format and load it using this option. The content of the file is then available in the text functions and the object comment fields of Pythagoras. You simply need to double click the appropriate text to add it to a text object or to the comment field. This can save yourself a tremendous amount of typing, if you make frequent use of the same texts/comments.



Conversion Table

- Printer: Color to Width
  A text-file may be used to define that colors need to be converted to a certain pen width and color during printing.
  Data structure:
  <color>-><color>,<width>

or *C<colornr>-><name color>,<width>*
or *C<colornr>->C<colornr>,<width>*
or *<color>->C<colornr>,<width>*
e.g. *MAGENTA->BLACK,W5*
YELLOW->RED,W7
C2->MAGENTA,W3
C14->BLACK,W14
C36->C14,W10
RED->C25,W20

- Printer: Width to Color
  A text-file may be used to define that the line width needs to be converted to a certain pen color and width during printing.
  Data structure:
  <width>-><name color>,<width>
  or *<width>->C<colornr>,<width>*

  e.g. *W1->BLACK,W2*
  W2->RED,W2
  W3->BLUE,W2
  W4->C5,W5
  W5->C13,W3

- DXF export: Width to Color
  In DXF files the width of a line cannot be specified. AutoCAD users normally use colors to specify line widths. This table can be used to specify the conversion of line width to color.

Note: You need to take into account that the use of widths is limited: you can use values from W1 to W20 (=line width 0.1mm tot 2mm).

- DXF Symbols and Layers

Activate the option "Use Conversion Table" when exporting a DXF/DWG file

```
; Angle Units only applicable for IMPORT !
AUNITS=0            ; 0: Decimal degrees, 2 ; GRADS (GON), 3 = Radials

ANGDIR=1            ; 1: clockwise ,0: counter clockwise

CODEPAGE= 0         ; = AutoCAD DWGCODEPAGE;
                    ; default = 0, dos850: dos code page


DEFAULT_LTYPE = Solid       ; Don't forget to indicate the standard
                            ; LTYPE in the LTYPES table.
                            ; This style will be used for all
                            ; linestyles that are not existing in the
                            ; LTYPE table when exporting to a DXF/DWG
                            ; file.

LTYPES(

1=My Linestyles,Fence       ; DXF LTYPE name = Pythagoras Linestyle
(Group,Name)
17=My Linestyles,Hedge
18=My Linestyles,Wall
40=My Linestyles,Green
Solid = 0,0                 ; 0, x: x means standard linestyle in
                            ; Pythagoras (solid, dot, dash, ...)
     )

DEFAULT_BLOCK = Symbdefault
                            ; Don't forget to indicate the standard
                            ; BLOCK in the BLOCKS table.
                            ; This style will be used for all symbols
```

```
                              ; that are not existing in ; the BLOCKS
                              ; table when exporting to a DXF/DWG file.

BLOCKS(

Symbdefault = 0,1             ; 0, x: x means standard symbol in
                              ; Pythagoras (round dot, triangle,
                              ; X point, ...)
RoundDot=0,2
RoundDotHollow=0,5
RectDot=0,6
2=0,3
3=My Symbols,Tree
4=0,8
19=My Symbols,Pole
221=0,4
     )

LAYERS(

1=W-HR,5,0,Solid              ; DXF/DWG LayerName = Pythagoras
                              ; LayerName,Default Color,
                              ; Group Linestyle, Name Linestyle
2=W-AL,5,0,Dash
3=W-HR,5,0,Dot
4=W-AL,5,0,Solid
5=HD-HR,1,My Linestyles,Wall
     )
```

Important remark:
When you print or save your work using conversion, check whether the options in the "Print" dialog box are set correctly.

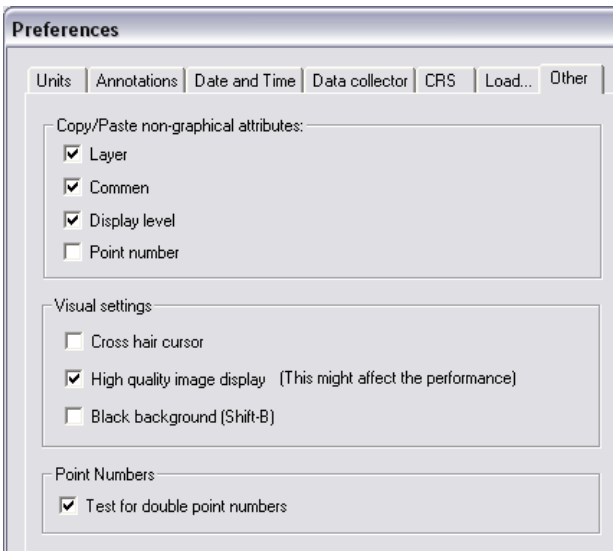
Terms Cross-section and Profile

This command loads a file containing terms that will be used for the descriptions in automatically generated profiles and cross-sections.

You can find an example of such a text-file in the examples folder that is installed during the installation of Pythagoras ('profiletexts.txt').

Other

In this tab you can some visual settings for Pythagoras, e.g., switch the background color to black, turn on testing for duplicate point numbers, and specify which attributes must be taken over when using copy/paste on an object. Before, only the layer and comment where copied (besides the visual attributes). Now also display level and point number can be copied as well.



Chapter 6: The View Menu

The 'View' menu contains menu items, which define how your drawing is displayed on the graphics screen of your computer.

The toolbox item "Pan" allows you to scroll the page over the drawing in any direction. Press the mouse button on a location of the drawing, move the mouse to its new location on the screen (you will notice that the drawing moves along) and release the mouse button. The visible area of your drawing will be adjusted accordingly.
While moving the mouse, a dashed line indicates the direction of the displacement.

The scroll mode can be cancelled by using one of the following keyboard keys: Escape, Space bar, Enter.

Note: A quick key to enter scroll mode is the "+" key on the numeric keyboard.

You can also scroll using the arrow keys on your keyboard.

Zoom In

With the "Zoom In" command ('View' → 'Zoom In') you can magnify a part of your drawing on the screen.

When you have selected this command, the shape of the cursor will change to a magnifying glass with a plus sign at the center. Move the cursor to a desired starting location (top left, top right, bottom left or bottom right of the area you want to enlarge), press the mouse button, and move the mouse. A rectangle on the screen will follow the mouse movements. When the rectangle encloses the area of the drawing you want to magnify, release the mouse button.

Note:

- *You will zoom in by a factor 2 when you simply click the mouse button on the position where you want to zoom in.*
- *When zooming in, symbols are by default magnified by the zooming factor. The amount of magnification can be set from 0 = no magnification to 100 = linear magnification.*

Pythagoras supports multiple zoom levels. Each time you zoom in Pythagoras will remember the previous displayed area and the zoom factor. This information will be used when you zoom out.

With "View-Actual size" you can read the actual scale in the upper left corner of your screen.

Note: The shortcut key is the ">" key.

Zoom Out

With the "Zoom Out" command ('View' → 'Zoom Out') you can reduce the size of your drawing on the screen.

The "Zoom Out" command will display the area of your drawing using the zoom factor at the previous zoom level.

Note: Shortcut is "<" key.

Actual Size

This command ('View' → 'Actual Size') will display the drawing on the screen at the same size as it will be printed.

Note: Shortcut is "=" key.

Fit In Window

This command ('View' → 'Fit In window') will display the complete drawing on the screen. The parts of the drawing that fall outside the page boundaries will not be displayed.

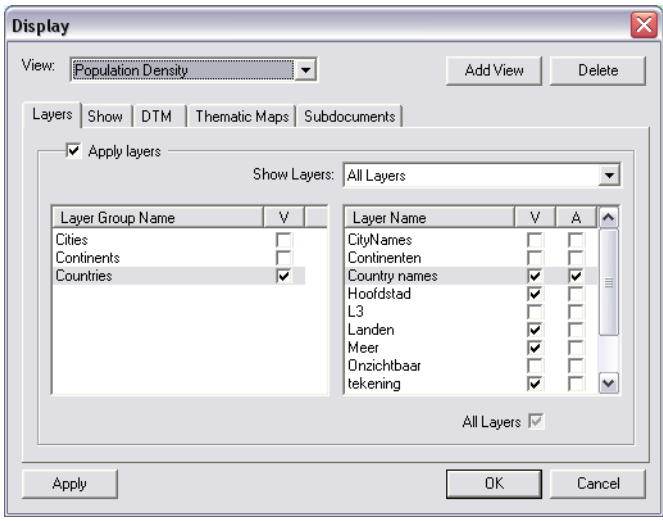
Note: Shortcut is "-" key.

Display View

The "Display View" Command ('View' → 'Display View…') allows you to control the way your drawing is displayed on the screen.

Note: Shortcut is CTRL+I.

A dialog box will appear when you select this command. To define a new View, click first the "Add View" button and give it a name. Otherwise, the changes you make will affect the current view.



The Display View dialog box contains 5 Tab Pages. Define the content of the just created view by selecting the preferred options in the Tab Pages:

1. The first Tab Page called "**Layers"** allows you to select the layers that need to be visible.

   The visible layers will be displayed on the screen, layers not marked visible will be hidden. Objects in hidden layers cannot

be selected, and you cannot perform any operations on them.

2. The second Tab, called "**Show**" allows you to specify objects and attributes that need to be visible:
   - point numbers,
   - comments,
   - point elevations,
   - polygon areas,
   - texts,
   - images,
   - special line styles,
   - polygon patterns.

   When "Show Texts" is selected, all text in the visible layers will be displayed on the screen. When "Show texts" is not selected, all text objects will be hidden.
   You can only select and drag text when "Show texts" is selected.

   Note: *When you create a new text object, Pythagoras will automatically select "Show texts", and the hidden text will be displayed.*

   When "Show Patterns" is selected, the polygon patterns of all polygons in the visible layers will be displayed. When "Show Patterns" is not selected, all polygon patterns will be hidden. However, the polygons in the visible layers can still be selected and all operations on polygons can be executed.

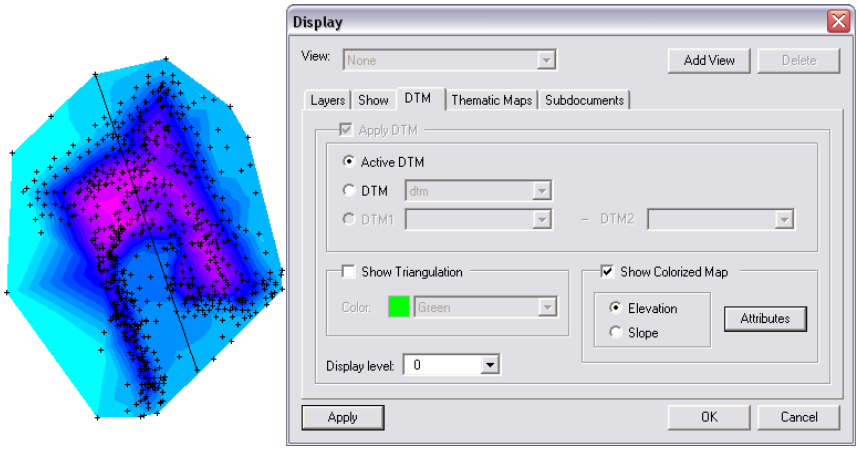
   Note: *When you change the fill pattern of a polygon, Pythagoras will automatically select "Show Patterns" and all hidden polygon patterns will be displayed.*

   When "Show Point Numbers" is selected, the point numbers of all points in the visible layers will be displayed. The point numbers displayed with this option are not text objects. The status of "Show Text" does not affect the visibility of the point numbers.

   Note: *The Annotation command "Point Number" ('Tools' → 'Annotation' → 'Point Number') will create a text object containing the point number of the indicated points. The visibility of these point numbers is not affected by the status of "Show Point numbers".*

   The same is true for "Show Point Elevations" and "Show Point Comments".

3. The Tab, called "**DTM**" allows you to specify certain parameters for visualizing DTMs (when applicable).



The active DTM can be selected, or a difference between 2 DTMs can be calculated. You can show the triangulation of the selected DTM in any color, and you can create a colorized map based either on elevation on slope of the DTM.

4. The Tab Page "**Thematic Maps**" allows you to activate thematic maps. More than one thematic map can be active at a time and all the maps you select will be visible in the drawing.

5. The Tab Page "**Subdocuments**" allows you to apply subdocument configurations.

Legend

This command ('View' → 'Legend') places a Legend of the active Thematic Map(s) or DTM(s) in the drawing. The size of the Legend can be changed by clicking and dragging the size of the Legend. The location can be changed by clicking and dragging the center of the Legend. The properties can be changed by using a right-mouse click.
When you are satisfied with the way the Legend looks, it can be "Frozen" in the drawing (Click the right mouse button and select Freeze or select it, then choose 'View' → 'Legend' → 'Thematic Legend' → 'Freeze').

Object Info

The "Object Info" ('View' → 'Object Info') lets you query the properties of an object or link an external file to an object. This means that it's possible to consult external files linked to an object from within Pythagoras, e.g. a polygon can be linked to a text-file containing cadastral information, etc.

Attributes

The "Attributes" command ('View' → 'Object Info' → 'Attributes…') will bring up a dialog box containing information about the selected object. The information about the object can be changed.

Note: Object Info is disabled if none or multiple objects are selected.

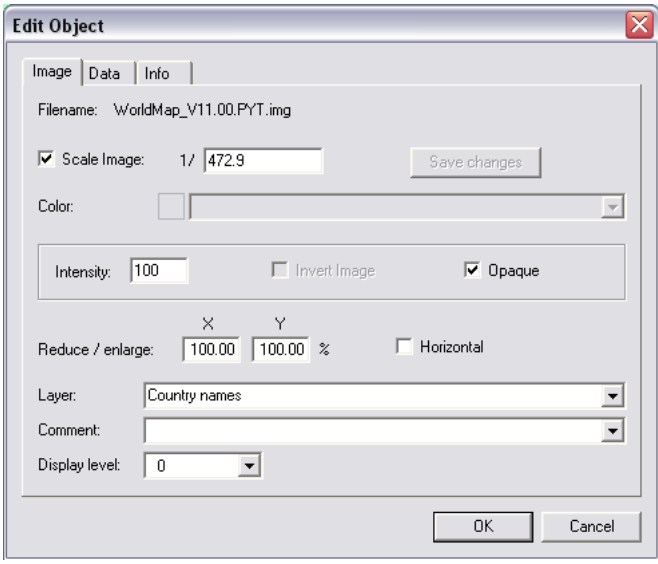


Image
For an image this information is:

- scale image,
- comment,
- layer,
- color,
- intensity,
- invert image,
- horizontal,
- opaque,
- scale factor,
- save changes.

Scale image

a) No scale is entered

If no scale is entered, the image will remain its original size (paper). When the drawing's scale is changed (print scale), it will not affect the size of the image; it remains unchanged.

E.g.: Photos,
Situation plans.

b) The original's scale is entered

The image will be displayed in real dimensions. This means that distances given by Pythagoras correspond with the distances on the field. In case of changing the print scale, the relation raster info – vector info remains unchanged. The vector data as well as the raster data will be scaled.

E.g.: Geo referenced maps.
Digitizing of maps (creating drafts).

Color

Only the foreground color of monochrome images (normally black) can be changed.

Intensity

100 = normal intensity: black remains full black.
50 = half intensity: black becomes gray.
0 = no intensity: everything is white.

Reducing the intensity allows you to enhance the contrast between the image and the digitized drawing. (The lines, points, patterns, etc. drawn on top of the image).

Horizontal

Since images can be rotated, they can also - just like text objects - receive the attribute "Horizontal". This will make sure that the image always remains horizontal in reference to the page.

Opaque:

This option specifies whether the image is or is not transparent.

Scale Factor (Reduce / enlarge)

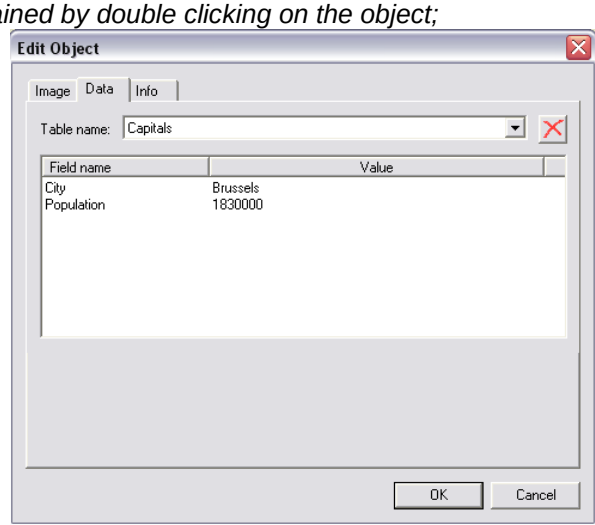
An image that has not been scaled (scale factor = 100) will be printed by Pythagoras at the same size as the original. An image can be scaled either just to change the size, for example of a picture, or to correct distortions in the x and/or y direction of the original.

Save changes

The modified image can be saved under another file name. This implies that the original can't be overwritten. It is possible that the image still is used in other drawings.

Note:

- *This function is also accessible by using the right mouse button;*
- *the same dialog box can be obtained by double clicking on the object;*
- *different dialog boxes will pop up if other objects are selected (e.g. line, point etc.)*



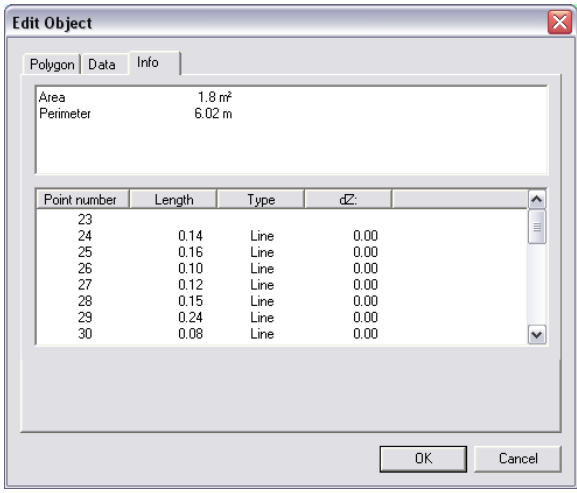
Data

The "Data" command ('View' → 'Object Info' → 'Data…') will pop up a

dialog box that contains database information about the selected object. The database information about the object can be changed.

Note:

- *Object Info is disabled if no (or multiple) objects are selected;*
- *the same dialog box can be obtained by double clicking on the object.*



[Info]

The ‘Edit Object’ dialog box has also a third tab ‘Info’, which shows additional information of all object types. For example, for a polygon it will be the area, perimeter, and the list of points and lines forming this polygon.

Open External File

This command ('View' → 'Object Info' → 'Open External File') opens the external file that is linked to the selected object. The external file can be any kind of file, such as a MS Word or MS Excel document, another drawing, etc.

Note: This function is also accessible by using the right mouse button

Choose External File

This command ('View' → 'Object Info' → 'Choose External file…') creates the link between the selected object and a file on your hard disk or URL. The external file can be any kind of file, such as a MS Word or MS Excel document, another drawing, etc, or any internet address.

If an object is linked to an external file or URL, it can be opened directly from within Pythagoras.

Folder External File

With this command ('View' → 'Object Info' → 'Folder External File…') you specify a folder/directory where you're keeping your linked files. This way you avoid entering the whole path name in the "Choose external file" command.

This becomes handy when files are moved to other computer systems. All files can be saved in one folder/directory so you just need to specify one folder per drawing.

External File Mode

This option ('View' → 'Object Info' → 'External File Mode') makes it possible to open files that are linked to objects by double clicking these objects. If no

file is linked to the object, the double clicking will bring up the "Attributes" dialog box.

Road Design

See PART III: Road Design.

Google Earth

You can view a Pythagoras drawing directly in Google Earth without exporting it first to a KML file. If you select 'View' → 'Google Earth', a KML file will be created in a temporary folder and Google Earth will be opened with this KML file as a parameter.

This menu option is only enabled if conversion to WGS84 coordinates is possible and any exportable objects (not in PageCS) are selected. All features are the same as when you export to Google Earth yourself (see PART II → Chapter 1: → Export: Google Earth).

Toolbars

Active DTM

This menu option ('View' → 'Toolbars' → 'Active DTM') hides or shows the "Active DTM" toolbar in the control panel.

Configuration

This menu option ('View' → 'Toolbars' → 'Configuration') hides or shows the "Configuration" toolbar. This toolbar is used to select a different subdocument configuration than the one that is currently active.

Defaults

This menu option ('View' → 'Toolbars' → 'Defaults') hides or shows the "User Defaults" toolbar. It is used to activate User Defaults (if they have been created).

Drawing Tools

This menu option ('View' → 'Toolbars' → 'Drawing Tools') hides or shows the "Drawing Tools" toolbar in the control panel.

Layers

This menu option ('View' → 'Toolbars' → 'Layers') hides or shows the "Layers" toolbar. This toolbar is used to select the active layer.

Macro Library

This menu option ('View' → 'Toolbars' → 'Macro Library') hides or shows the "Macro Library" toolbar, which allows you to activate a Macro Library.

Sheet

This menu option ('View' → 'Toolbars' → 'Sheet') hides or shows the "Sheet" toolbar. This toolbar allows you to make a sheet active.

Snap Info

This menu option ('View' → 'Toolbars' → 'Snap Info') hides or shows the "Snap Info" toolbox. It allows you to view and change the status of snapping to specific object types.

Standard

This menu option ('View' → 'Toolbars' → 'Standard') hides or shows the "Default" toolbar. This toolbar contains items such as the icons to create a new document, to open an existing document, undo/redo, etc.

Subdocument

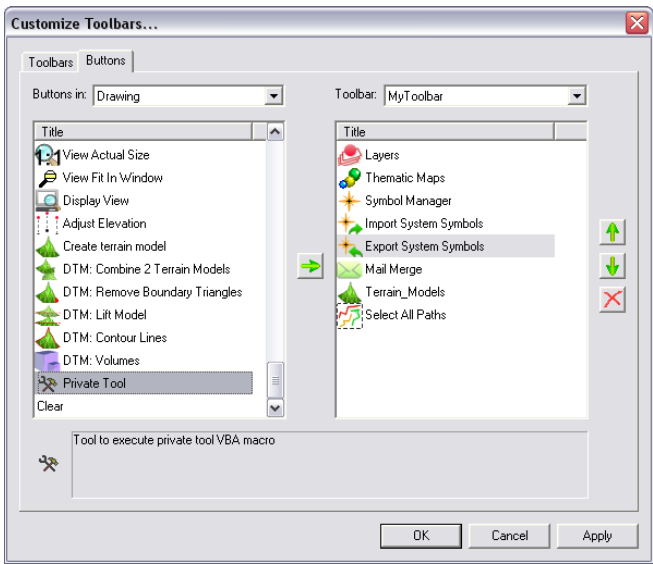
This menu option ('View' → 'Toolbars' → 'Subdocument') hides or shows the "Subdocument" toolbar. This toolbar is used to select a different subdocument than the one that is currently active.

View

This menu option ('View' → 'Toolbars' → 'View') hides or shows the 'View' toolbar. This toolbar is used to select a different view than the one that is currently active.

Customize Toolbars…

This menu option ('View' → 'Toolbars' → 'Customize Toolbars…') invokes a



dialog that allows you to manage existing toolbars and create your own.

The first tab ‘Toolbars’ contains the list of all available toolbars. You can toggle the toolbars’ visibility on and off, dock toolbars to comfortable positions, change their sequence, and create new toolbars. If you press the button ‘Reset’ at any point of time, all custom toolbars will be deleted.

The second tab ‘Buttons’ allows you to customize the contents of the toolbars that you created. Add or remove available buttons from the left list to your toolbar and select the sequence of the buttons in the list on the right.

Drawings in the View Menu

All open drawings will be listed in the View menu. Selecting a drawing in this menu will make that drawing the active drawing. Its window will become the top window.

Chapter 7: The Calculations Menu

Intersections

The "Intersections" command ('Calculations' → 'Intersections') calculates the intersections of all selected lines and adds the resulting points to the drawing. The point style of intersections is "x-point".
When lines cross each other instead of intersect, the point gets the average elevation.

Center

The "Center" command ('Calculations' → 'Center') calculates and creates the center of the selected arcs and circles.

Grid

This command ('Calculations' → 'Grid…') allows you to generate a grid consisting of points or lines, separated by a pre-defined distance. You can also have Pythagoras add text next to each point that was created. The default text is the coordinates in reference to the active coordinate system. You can change the formatting, layer, color and display level.

Best fit

This command ('Calculations' → 'Best Fit') calculates and creates the best fitting line, arc or circle (on a DTM). The calculation is based on the least square method.

Traverse

The "Traverse" command ('Calculations' → 'Traverse') calculates the precision, the errors of closure and the coordinates of a traverse.

The closed traverse and the following 5 cases of open traverses are provided.
The Traverse dialog box refers to points 0, 1, n and n+1. Point 1 is the starting point of the traverse and point n is the end point. Points 0 and n+1 (the reference points) define the orientation of the starting point and the end point respectively.

Pythagoras provides the following cases:

- points 0 and 1 are known

- points 1 and n are known
- points 0, 1 and n are known
- points 0, 1, n and n+1 are known
- points 0, 1 and n+1 are known

The traverse dialog box is adapted to the case you select. Before starting to give in the traverse data, you need to fill in the coordinates of the starting point, the end point and of the orientation points. If these points exist in the active drawing, you may enter the point numbers. Pythagoras will display the coordinates.

When all points are entered, you may continue to enter the traverse data. Using the "<" and ">" button, you can scroll through the data you have entered, and the input data can be edited.
Once all data has been entered, the coordinates of the traverse points will be calculated. Pythagoras calculates the precision and the errors of closure (if applicable for the given type of traverse), and the results will appear in the dialog box.
With the "close" check boxes you can control whether the coordinates of the traverse will be unclosed, partially closed or totally closed.

The "Create Points" button will create all points of the traverse on the drawing.

Intersection

The "Intersection" command ('Calculations' → 'Intersection…') calculates the point of intersection for the following situations:

- Angle - Angle: calculates the point of intersection of two lines given a point on, and the angle of, each line.
- Distance - Distance: calculates the point of intersection of two lines given a point on each line and the distance from the point to the intersection.
- Angle - Distance: calculates the point of intersection of two lines given a point on each line, the distance from the point to the intersection of one line, and the angle of the other.

When the coordinates of the points named P1 and P2 in the Intersection dialog box are entered, you select the type of intersection and you fill in bearing(s) and/or distance(s).

When the "Calculate" button is pressed, the point (or points) of intersection is (are) calculated. When two solutions are found, you can select one of the solutions.
The point of intersection may be created on the drawing using the "Create Point" button.

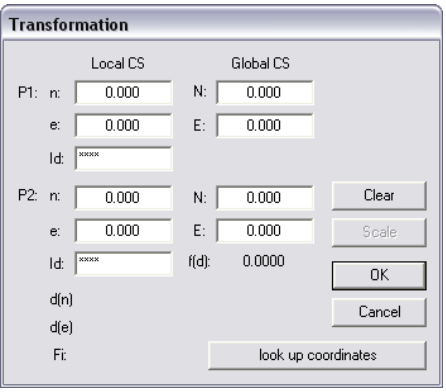
Resection

The "Resection" command ('Calculations' → 'Resection…') calculates the location of an unknown point from three known points and angles.

When the coordinates of the points named P1, P2 and P3 in the Resection dialog box are entered, you can enter the angles P1-P2 and P1-P3. The resulting point may be created on the drawing using the "Create Point" button.

Transformation

2 points



The "Transformation" function of Pythagoras ('Calculations' → 'Transformation' → '2 Points…') allows you to define the transformation between the local coordinate system which is the default coordinate system and a second coordinate system called the global coordinate system (see PART I → Chapter 1: Coordinate Systems).

With the "Look up coordinates" button, points with identical point numbers will be searched for in another drawing. The coordinates of the points found in the other drawing will automatically be inserted in the dialog box.

Use the button "Scale" in order to change the scale of the complete drawing so that the local and global coordinates of both points defining the transformation match exactly.

A global coordinate system is used if you want to copy and paste between two drawings with a different local coordinate system.

Defining transformation parameters

With a translation without rotation (P1=P2):

P1 and P2 must contain the same coordinates. First you need to fill in the coordinates of the local system and then those of the global system. This results in a parallel displacement of the coordinate system

With a translation with rotation (P1≠P2):

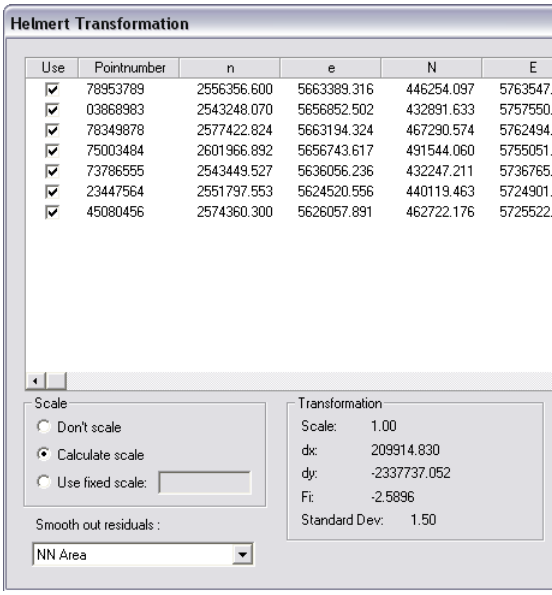
In this case you need to enter the coordinates of two points whose coordinates are known in both the local and global coordinate system.

The new calculated coordinate system will be active when the OK button is pressed.

Helmert transformation

This command ('Calculations' → 'Transformation' → 'Helmert transformation…') allows you to calculate the best transformation, starting from several points whose coordinates are known in another coordinate system. This calculation is often useful. For example it could be required to transform a drawing to some standardized land coordinate System (e.g. State-Plane). If the coordinates of at least 3 points are known in the other coordinate system, the function "Helmert transformation" will calculate the best transformation parameters.

Select the points whose coordinates are known and select the menu item 'Calculations' → 'Transformation' → 'Helmert transformation…'. The number of points is not limited, The Transformation dialog box will display the selected points and their local coordinates. Enter the coordinates in the new coordinate system (or load them from a file using 'Load from File' button) and calculate the transformation. Pythagoras will calculate the parameters based on the least square method.



Using the "Look up XY coordinates" button, Pythagoras will search for points that have identical point numbers in another drawing. The coordinates of the points found in the other drawing will automatically be inserted in the dialog box.

You can define whether a transformation scale parameter should be calculated by Pythagoras. It is also possible to define a scale parameter. Pythagoras will display the transformation parameters: scale, dX, dY, and the rotation angle Fi. Also the standard deviation is shown. If the maximum tolerance is known, Pythagoras will indicate the points that are outside the maximum tolerance. Points that need to be removed from the calculation can be deselected.

You can also choose to smooth out residuals. There are two options: Natural Neighbors by Area (NN Area) and Inverse Distance Weighting ($1/s^2$). These smoothing methods are described in PART I → Chapter 1: → Tie Points.

After the calculation is complete and you are content with the result, you can save it to a file as a

- Rich text table (.rtf),
- Webpage table (.html),
- Text table separated with comma (.csv), semicolon or tabs (.txt).

Affine transformation

The command 'Calculations' → 'Transformation' → 'Affine transformation …' provides you a tool to calculate the affine transformation, starting from several points whose coordinates are known in another coordinate system.

Select the points whose coordinates are known and select the menu item 'Calculations' → 'Transformation' → 'Affine transformation…'. This dialog box is very similar to the previous Helmert transformation. Enter the coordinates in the new coordinate system (or load them from a file) and calculate the transformation. Pythagoras will calculate the parameters based on the least square method.

Using the "Look up XY coordinates" button, Pythagoras will search for points that have identical point numbers in another drawing. The coordinates of the points found in the other drawing will automatically be inserted in the dialog box.

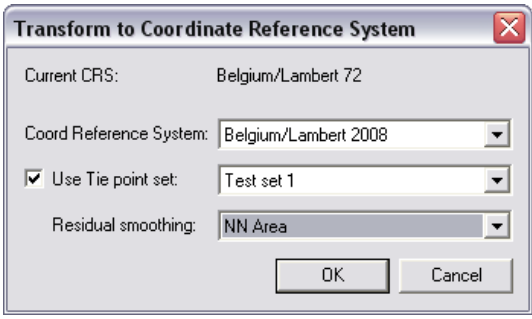
In this transformation you cannot define any parameters, they will be calculated by Pythagoras and shown in the dialog box: scale X and Y, dX, dY, rotations angles Fi X and Fi Y, and the standard deviation. If you give the maximum tolerance, Pythagoras will indicate the points that are outside the maximum tolerance. Points that need to be removed from the calculation can be deselected.

Again, you can choose to smooth out residuals either with the Natural Neighbors by Area (NN Area) or with the Inverse Distance Weighting ($1/s^2$) methods.

Adjust Elevation

This command ('Calculations' → 'Adjust Elevation…') allows you to adjust the elevation of all objects in the drawing. The height difference can be defined by entering the number of a point in the drawing. Pythagoras will display its elevation and subsequently you must enter the new elevation of this point. If for example the new elevation of a point is 7m and the original elevation is 4.8m, then the elevation of all objects in the drawing will be increased by 2.2m.

To other CRS

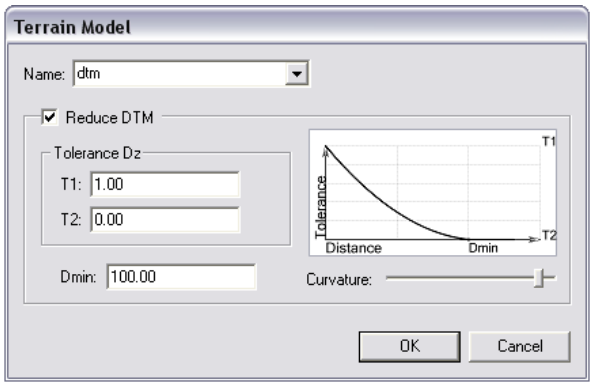


This command ('Calculations' → 'to other CRS…') allows you to transform one CRS to another using a Tie Points set if applicable.

DTM

Terrain Model

The command "Terrain model" ('Calculations' → 'DTM' → 'Terrain Model…') calculates a Delaunay triangulation.



After having selected the points, lines, arcs and maybe a polygon, you call the "Terrain model ..." in the menu "Calculations". Now you can enter a name for the terrain model.

Complexity of the DTM (the number of triangles) can be reduced if a certain error is acceptable. The tolerance (error) is defined as a function of the distance of the point to the endpoints of the triangle the point lies in. For smaller error values, frequent peaks are omitted, but the general trend for increasing elevation is noticed. For larger error values, on the contrary, all the frequent terrain changes will be noticed and not the smooth elevation changes.

Once a Terrain model has been calculated, the control panel will show the elevation on the position of the cursor in the drawing.

A Terrain model can be deleted by clicking the "Delete" button in the Terrain Models manager described in PART II → Chapter 1: → Terrain models.

You can hide a terrain model by deselecting the 'Show Triangulation' check box in the '**DTM**' Tab Page from "Display View" dialog box.

Combine 2 Terrain Models

You can use this command ('Calculations' → 'DTM' → 'Combine 2 Terrain Models…') to create a third terrain model that is based on the combination of 2 other terrain models. This is useful for calculating cut-and-fill areas.

Remove Boundary Triangles

You can use this command ('Calculations' → 'DTM' → 'Remove Boundary Triangles…') to remove boundary triangles that have very small angles and/or edges larger than a given value.

Make Delaunay

This command ('Calculations' → 'DTM' → 'Make Delaunay') recalculates the Active DTM so that it becomes a Delaunay triangulation.

Note: *When a new DTM is made, it is always a Delaunay triangulation. But when editing a DTM, only the directly affected triangles are changed. This is mostly the purpose. If anyway you want to make a modified DTM Delaunay, this command allows you to do it.*

This function will make the DTM completely Delaunay without taking into account
(1) original breaking lines and
(2) any Swap Diagonal operation(s) eventually done.
Pythagoras will give you a warning when you select this command and ask you for confirmation.

Change Elevation

This command ('Calculations' → 'DTM' → 'Change Elevation') converts DTM by adding a given value (which can be negative) to the z-coordinates of all vertexes.

Contour Lines

The command "Contour Lines" ('Calculations' → 'DTM' → 'Contour Lines…') will generate contour lines based on the selected Digital Terrain Model. The line style, the equidistant, the color and layer may be specified. The contour lines will become Pythagoras polyline objects. Any operation on polyline objects will be applicable to contour lines.

The contour lines will be drawn within the boundaries of the selected Digital Terrain Model.

To annotate the elevation of a contour line, select the menu item 'Tools' → 'Annotation' → 'Elevation' and click on the contour line.

Volumes

The command "Volumes" ('Calculations' → 'DTM' → 'Volumes…') calculates the volume within an area defined by the selected polygon. The polygon defining the boundary for the volume calculation may contain points, lines and arcs.

Note: *If the polygon lies partly outside the terrain model, the volume of the non-overlapping part will be estimated based on extrapolation of the DTM.*

When a two or more terrain models have been calculated, you can select the appropriate terrain models from the pop-down-box. When you make this selection, Pythagoras will calculate the volume between two terrain models.

The result of both the cut and fill will be given.

Click the button "Save Result" when you want to save the result of the last calculated volume. A text-file will be created with an overview of the volumes of all cross sections.
This file can be opened quickly by selecting the name of the file in the menu 'File' → 'Open text files'.
You also have the choice to save it in the REB format, but because this format is only used in Germany we will not go into it.

Cross Section

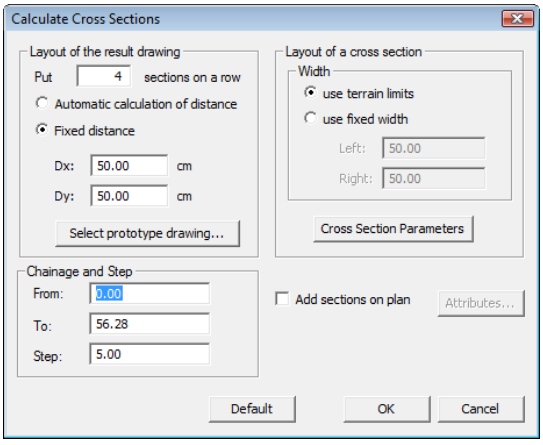
Along Path

The command 'Calculations' → 'DTM' → 'Cross Section' → 'Along Path' will calculate and create a profile along a selected path from your drawing (please refer to PART II → Chapter 3: → Path to create paths).

The initial start value of these accumulated distances can be different from "0". A new value can be entered in the path's attributes window (by double clicking on the path or via the menu View – Object Info - Attributes)

You can also add reference objects to the cross-section. Select the reference objects along with the path, prior to selecting the menu option 'Calculations' → 'DTM' → 'Cross Section' → 'Along Path'. You may also want to refer to the section of the tutorial that covers this topic.

Perpendicular to Path



The command 'Calculations' → 'DTM' → 'Cross Section' → 'Perpendicular to Path' will calculate and create a number of profiles perpendicular to the selected path from your drawing (please refer to PART II → Chapter 3: → Path to create paths).
The appearing dialog box will allow you to enter some personal settings that will be applied.

Layout of the result drawing:

The calculated profiles will be pasted automatically in a new drawing and they will be put on the clipboard as well. Use the "Paste" or "Paste Special" command to insert the profiles in an existing drawing.

The chosen parameters in the "Layout of the result drawing" will be applied to the new drawing.

The button 'Select prototype drawing…' allows you to select an existing (prototype) document in which the profiles need to be pasted.

Chainage and Step:

Here you can specify which part of the selected path should be used for the calculation of the sections. Pythagoras will take the limits from the path as default values. Also the number of steps can be entered, this is the intermediate distance between 2 profiles.

Layout of a cross section:

The button "Cross Section Parameters" allows you to select the terrain models to be shown in the calculated sections. You can choose to display a DTM in the profile itself and/or in the legend under each profile.

Add sections on plan:

All generated profiles can be indicated on your original drawing. Lines perpendicular to the selected path will be generated, with our without profile numbers. The attributes of these lines can be specified by clicking on the "Attributes…" button after activating the "Add sections on plan" checkbox. The attributes of the section lines can be specified in the next dialog box.

3D-View

The command 'Calculations' → 'DTM' → '3D-View' will generate a perspective view of the active Terrain model. When you select this command, the cursor changes in a camera symbol. First, click in the drawing on the viewpoint for the perspective. You do not need to click on an existing point. You enter the height of the camera in the z value of the control panel. Then click a second time on the drawing to indicate the view direction. Again, you don't need to select an existing point and you can insert a height. Now the viewing angle and direction are specified. A dialog box appears and you can select the number of grid lines and change the scale of the level axis.

There are two kinds of models:

1. a "Lines" model,
2. a "Grid" model.

The first model will appear during construction. If you click within the 3D model, your actual drawing will reappear. During the calculation of the second kind of model, a progress indicator will come up indicating the progress of the calculations.
You can cancel the calculation by pressing the ESC-key. The 3D View is placed on the clipboard. Use "Paste" or "Paste Special" to paste the 3D View in the current drawing or in a new drawing.

Remarks:

- *The grid lines are drawn as Pythagoras polyline objects.*
- *A 3D View can only be calculated of terrain model with a maximum of 50000 points.*

Slope Intercept

This command ('Calculations' → 'DTM' → 'Slope intercept') allows you to calculate a slope intercept. The selected path indicates the top or bottom of the slope intercept. You have the choice to calculate a slope intercept, which connects to the terrain at a fixed slope or a slope intercept with a fixed distance.

Connection to the terrain
A slope intercept can be connected to:
- a horizontal plane
- an existing terrain model

Left-Right
You have the choice of calculating the slope intercept either left or right of the selected path.

Gradient
The gradient of the slope intercept both upwards and downwards needs to be given.

Step or Cross Section
The step is the distance of points on the path used to calculate the connection points of the slope intercept. A small step will yield a more precise result. A very small step could yield too many points when the path contains arcs.

Maximum width
The calculated connection point will not be generated on the drawing if the distance to the path is larger than the maximum width.

Slope Area

To calculate a 2 and/or 3-dimensional area, simply calculate the DTM, specify the perimeter of the area by creating a polygon, and select the menu option 'Calculations' → 'DTM' → 'Slope Area…'.

A dialog window will pop up that specifies both 2D area (horizontal area) and 3D area.

Note: *If the polygon lies partly outside the terrain model, the slope area will be estimated.*

PART III Road Design

Chapter 1: Concepts

Start with (a combination of) a line, an arc, a path (no spline!) to activate 'Road Design' from the 'View' menu. To activate an existing road project, hold down the letter 'R' while selecting the road. A path with a profile created in Pythagoras v11 will be automatically converted to a road in Pythagoras v12.

Pythagoras has 3 special windows: the "Profile" window, the "Plan" window and the "Cross Section" window, each with their own control panels. All windows can be viewed simultaneously.

The Plan Window

The plan window displays the horizontal alignment of the road and the existing terrain in plan view. Points and lines selected as reference objects are displayed in the plan window. These reference objects can be fixed points and lines that need to be taken into account when the horizontal alignment is being designed.

In the plan window you design the horizontal alignment of the new road axis. More specifically, you define the horizontal transitions and intersection points. Those transitions can either contain straight lines, arcs and splines.

The Control Panel

The control panel constantly displays the information about the horizontal alignment at the position of the cursor in the plan window.

When the cursor comes near an object (intersection point, transition object or reference object), the control panel will display the relevant information (distance, height and difference in height). When moving the cursor in the plan window, you will obtain instantly the distance, the inclination and the data of a horizontal transition at the position of the cursor.

Buttons for the creation of intersection points are provided. Using the control panel you can define the position of an intersection point exactly.

The Profile Window

The profile window displays the centerline of the road and the existing terrain in profile according to the station distance. The scale factor can be changed to exaggerate the elevation difference. Points and lines indicated in the plan window can also be shown in the profile window. These reference objects can be fixed points and lines that need to be taken into account when the profile is being designed. The height of the reference objects may be changed in the profile window. Therefore, reference objects also can be objects whose position and height need to be defined in function of the profile of the road (e.g. sewage, cables, pipes, etc.).

In the profile window you design the new profile. More specifically, you define the inclinations, the position and parameters of the vertical curves and the position and type of cross sections and cross section markers.
The vertical curve can be either a circular arc or a parabola. The radius and the length can be changed at any time.

The Control Panel

The control panel constantly displays the information about the profile at the position of the cursor in the profile window.

When the cursor comes near an object (intersection point, cross section, or reference object) the control panel will display the relevant information. When moving the cursor in the profile window, you will obtain instantly the distance, the inclination and the data of a vertical curve at the position of the cursor.

Buttons for the creation of intersection points and cross sections are provided. Using the control panel you can define the position of an intersection point exactly. Similar to the use of the control panel in the plan window of Pythagoras, you can enter the distance, the elevation or the inclination left or right. Also the exact position of a cross section is defined by using the control panel.

The Cross Section Window

The Cross section window displays the cross section at the position of the cursor in the profile window. The cross section window displays the existing terrain, the cross section, the slopes, the superelevation and the reference objects. By moving the cursor slowly from left to right over the profile window, the cross-sections will be displayed as in a movie. This is very helpful during design.

The Control Panel

The type of typical cross section can be selected from the control panel. The control panel allows entering the values for topsoil calculations.

Typical Cross Sections

You design a typical cross section by making a drawing of it in a Pythagoras document. All drawing functions can be used. Therefore, a typical cross section can contain lines, arcs, fill patterns and text. The centerline of the road, reference points and slope intercept points must be indicated. A typical cross section can be saved either as a document or a library typical cross section. Offset, width and slope should be entered if you want to apply superelevation on your cross section.

When the elevation heights in a road become too large, Pythagoras will automatically adjust (and round) the reference level when calculating cross sections to obtain a clear and organized result.

Finishing profiles and cross sections

When the design is completely finished, Pythagoras can generate a detailed drawing of the longitudinal section. This drawing is placed on the clipboard and will be pasted in a new drawing as well. If required you can adapt the drawing or add some additional information. You have the choice to place all or some of the following information in the detailed drawing: the distance, existing terrain, the information of the vertical curves, the height and position of the reference objects.

You can also obtain a detailed drawing of each cross section defined in the profile window. The distance relative to the centerline of the road, the height of the existing terrain, the height of the design and eventual reference objects can be placed in the detailed drawing.

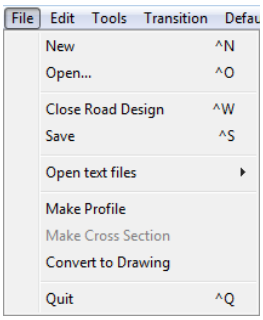
It is possible to select more cross sections (holding down SHIFT while selecting the cross sections) and put these in one drawing. The positions of cross sections and section numbers are indicated in the plan window on the road.

Chapter 2: Menu Items

Chapter 2: Menu Items

The Road Design mode has a menu similar to the main menu of Pythagoras. Here we provide a detailed description of the menu functions.

1. File Menu



The file menu is used to organize your Road Design projects.

New

The New command creates an empty drawing in a new window.

Open

The Open command opens a drawing and displays it on your screen.
When Open is selected the standard "Open" dialog box will appear.
To open a drawing, either select the drawing you want to open and click the "Open" button, or double-click the name of the drawing.
If you want to have more information on the possibilities of the "Open" dialog box, consult the Windows manual.

Close Road Design

The "Close Road Design" command closes the road design.

Save

The "Save" command saves the active drawing and the accompanying profiles on disk using the filename displayed on top of the window. If it was a new drawing, a dialog box appears requesting the name of the new file.
The profile information (the profile and its attributes, reference objects, etc.) are saved together with the information of the path to which the profile belongs.

Open text files

This command allows opening new or existing text files in the Pythagoras text editor.

Make Profile

The "Make Profile" command creates a dressed up drawing of the profile on the clipboard of the computer.
In addition, the dressed up profile becomes an independent drawing. With the editing functions of Pythagoras you can make any changes you need.

When "Make Profile" is selected, a dialog box will appear. You can enter the following information:

- Height of the reference elevation,

- From chainage
- To chainage
- Floating
- Reference level
- X-scale,
- Y-scale,
- Annotations you would like included on the dressed up drawing,
- DTM.

To generate a profile that does not cover the complete road, the chainages in From and To fields indicate starting and ending chainage of the profile section that must be generated.

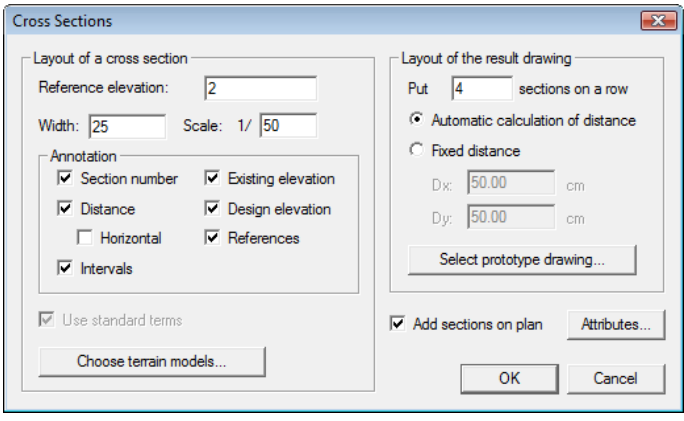
If "Floating" is switched on, the requested referenced level will be applied if the lowest part of the profile, including references, and DTM, is in a band that lies between 2 and 10 cm (paper dimensions) above the reference level. If the profile is outside this band, the reference level will be calculated by the program.

Make Cross Section

This menu item is enabled if one or more cross sections are selected in the profile window.
The "Make Cross Section" command creates a dressed up drawing of the cross section(s) on the clipboard of your computer. The clipboard content will be pasted automatically in a new drawing. With the editing functions of Pythagoras you can make any changes you need.

When "Make Cross Section" is selected, a dialog box will appear. You can enter the following information:

- the height of the reference elevation,
- the width of the drawing,
- the scale,
- the annotations you want to have on the dressed up drawing,
- DTM.



The field "Width" gives the total width of the dressed up cross section. It is obvious that the width must be large enough to display the connection of the cut or fill slopes with the terrain.

When multiple cross sections are selected, a different dialog box appears. In this dialog box you can change the reference height, the width, scale, annotation and DTM, as well as the lay-out of the drawing:

- The number of profiles on a raw,
- Distance of the profiles,
- Prototype drawing.

Convert to drawing

This function provides the automatic drawing of all calculated data (like road axis, reference points, slope intercepts,…) in the plan view. You can also create stake out points automatically. All you have to do is check the checkboxes of the appropriate elements you want to create.

The properties of the objects you want to create can be set in the dialog box that pops up after selecting this tool in the menu.
Following settings can be made:

- Line style,
- Line width,
- Color,
- Layer.

You can also set the precision of the calculation. There are two possibilities:

- With a given number of steps,
- With a distance between the theoretical profiles.

It is obvious that the higher the number of steps or the lower the distance between the profiles, the more precise the result will be.

Remark: After you make your design and you click in the menu 'File' → 'Convert to drawing' WHILE pressing the CTRL key. This is not the normal way but the result is mathematically better with CTRL key pressed. The road objects are split up into arcs, spirals and tangents in the ground plan. Without CTRL key, those are converted into a spline (containing only straight lines), but you will be able to give colors, layers, etc. to the splines.

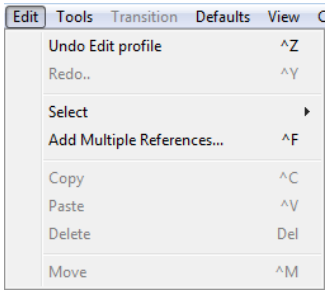
All elements from your design will be included in your ground plan drawing. Distances and angles can be measured; the drawing can be exported to DXF/DWG.

Quit

The "Quit" command closes all the windows on your screen and ends the Pythagoras session. If you have made changes to the drawing but have not saved them, Pythagoras will present a dialog box for each non-saved drawing.

When you quit, Pythagoras saves all session information to a file. The session information file (PYTHAGOR.DEF) contains the defaults and preferences that were set at the moment you quit Pythagoras. The next time you start Pythagoras this session information will be restored.

2. Edit Menu



The 'Edit' menu allows executing some standard operations like "Undo" and "Redo" and has in addition typical Pythagoras menu items.

Undo

The "Undo" command restores the profile to the state prior to the last executed editing command.

Remark: A new editing command after "Undo" will clear the "undone" editing commands from the undo list!

Redo

The "Redo" command reverses the "Undo" command.

Select

The "Select" command allows to select 1 or more cross sections, cross section markers or all cross sections and cross section markers in the profile window.
In the plan window the ‘Select’ command allows to select intersection points, reference objects and cross section markers.
In the cross section window only intersection points can be selected.

Add Multiple References

The "Add Multiple References…" command launches the intelligent search engine where you can specify the characteristics of the objects you want to add to your project as reference objects.

Copy

The "Copy" command copies the selected object(s) to the Pythagoras clipboard.

Paste

The "Paste" command pastes the objects from the Pythagoras clipboard in a Pythagoras document.

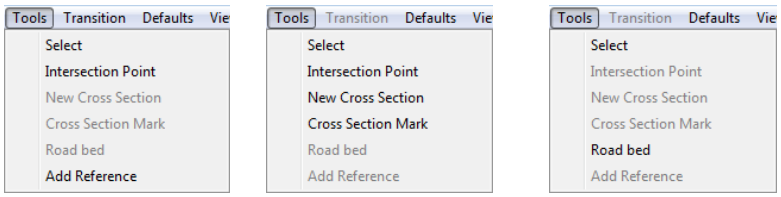
Delete

The "Delete" command removes the selected objects from the drawing.

Move

The "Move" command allows you to move a selected intersection point to another location.
First you select an intersection point. Next, select the item "Move" in the 'Edit' menu. The shape of the cursor will change. Place the cursor on the selected intersection point, press the mouse button, and drag the intersection point to the new position.

3. Tools Menu



The 'Tools' menu allows selecting design tools, as possible from the different control panels. The content of this menu will vary depending on the activated view ("Plan", "Profile", "Cross Section").

Select

By choosing the item 'Select' in the 'Tools' menu (or by pressing the corresponding toolbox button), the program will enter the select mode.

In the "Cross Section" window only intersection points can be selected.

In the "Plan" window intersection points, reference objects and cross section markers can be selected.

In the "Profile" window you can select intersection points, cross sections (normal and exceptional) and reference objects:

- Cross sections can only be deleted.
- Intersection points can be deleted or moved.
- Reference objects can be deleted.

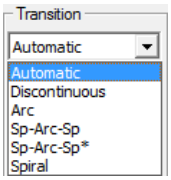
When you double-click on an intersection point, you can change the attributes, namely the position and the parameters of the vertical curve. When you double-click on a cross section, you can change the type of cross section.

Intersection Point

The command "Intersection Point" (or pressing the corresponding toolbox button) allows you to add intersection points in the profile or plan window. When the position of the intersection point is confirmed, Pythagoras will automatically create a vertical curve in the profile window or adapt the horizontal alignment in the plan window.
Depending on the status of the item "Point Confirmation" in the 'Default' menu, you may need to confirm the position of the intersection point in the control panel.

In "Profile" Window: When Point Confirmation is on, you can enter the Distance (dS), the elevation (Z), the inclination left (%L) and right (%R), and the radius (R) or length(L) of the vertical curve.
The vertical curve will either be an arc of a circle or a parabola depending of the settings of "Vertical Curve" in the menu 'Default'. When the radius or length of the vertical curve is not specified, the arc will start in the midpoint of the shortest leg.

In "Plan" Window: When Point Confirmation is on, you can enter the horizontal position (X, Y coordinates), the type of transition and depending on the chosen type parameters like length, radius and K factor.



Type of transition:

- Automatic: formula

$$R = \frac{V^2}{127(e+f)}$$

where:
R = Radius (m)
V = design speed (km/h)
e = max superelevation in m/m
f = friction
These values can be defined in the menu 'Defaults' – 'Road characteristics'.

- Discontinuous
- Arc: R
- Sp-Arc-Sp: R, and K-factor:
  In this type of transition, the spiral in and spiral out are symmetric. You only have to define the spiral in.
- Sp-Arc-Sp*: spiral in: R, L and K-factor AND spiral out: R, L and K-factor
  Here the spiral in and spiral out are asymmetric.
- Spiral: R and L

New Cross Section

The command "Cross Section" (or pressing the corresponding toolbox button), allows you to add cross-sections in the profile.
Click the mouse button at the location where you want to add a cross section. After confirming its position, a dialog box will appear. You can either select a document or a library typical section. You can even indicate whether the cross section is exceptional. This means that this cross section is only applicable at the location where it is made.

By selecting the toolbox button and clicking on a reference point or intersection point in the plan window you can create a cross section exact on that point of the road axe where that intersection point or reference point is situated. The cross section will be projected perpendicular from that reference point or intersection point to the road axe.

Cross Section Mark

The command "Cross Section Mark" allows to enter a number of markers on your profile. It is not possible to specify the type of cross section. Those markers are used to create cross section drawings on the indicated positions.

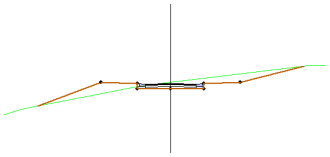
Road Bed

In the menu 'Tools' → 'Road Bed' you can determine the roadbed. A red line will appear (roadbed) on the cross-section, going from the left slope to the right one, once you select this tool.

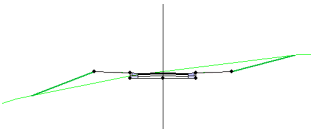
Creating points in the road body does this. Every time you create a point, you will need to confirm with "OK" or you can adjust the X and Y values. The X,Y coordinates in this window are relative to the hotspot of the typical section (hotspot = 0,0)

If you want to cut or fill topsoil, you do the following operations:

- Double click on any point from the road bed (with the normal selection cursor).
- Enter the values for topsoil cut, fill and bulking factor in the control panel. By confirming these values you will return to the cross section window.
-
  In the control panel you choose the button to indicate the parts of topsoil that need to be excavated. Click in the cross section window on those parts that need to be excavated. These parts will be displayed in brown



Then, if necessary, you can use the button to indicate the parts of topsoil that need to be filled. These parts will turn green.



By confirming in the control panel, you will return in the cross section window. In the profile window the cross sections used for cut and fill calculations will be displayed in brown or black. The brown cross section means that everything is OK about that cross section: parameters (width,

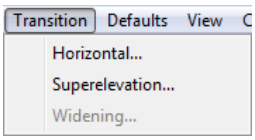
slope, ...), road bed points and topsoil parameters.
The black one means that there is something wrong about these parameters and it asks for some verification.

You can also add an exceptional cross section. This is a cross section that will be used only on that place where it was added (ex). These profiles are displayed in orange.

Add Reference

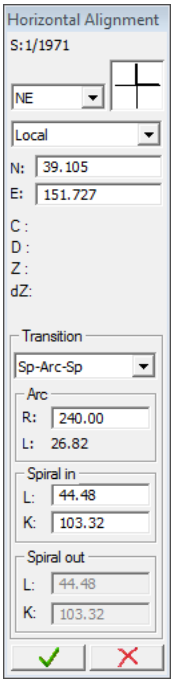
The Add Reference command allows to add a single reference object to your project.

4. Transition Menu



Horizontal

The menu is only available in the plan window.
When an intersection point is selected, the values can be adjusted in the control panel:



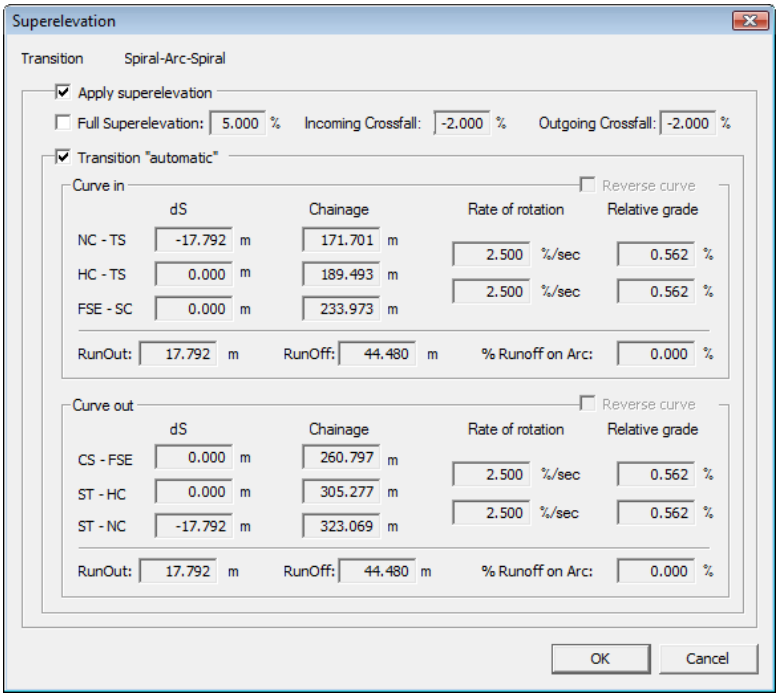
- X and Y coordinates
- Type of transition and characteristics:
  - Automatic: formula

$$R = \frac{V^2}{127(e+f)}$$

    where:
    R = Radius (m)
    V = design speed (km/h)
    e = max superelevation in m/m
    f = friction
    These values can be defined in the menu 'Defaults' → 'Road characteristics'.

  - Discontinuous.
  - Arc: R.
  - Sp-Arc-Sp: R, and K-factor:
    In this type of transition, the spiral in and spiral out are symmetric. You only have to define the spiral in.
  - Sp-Arc-Sp*: spiral in: R, L and K-factor AND spiral out: R, L and K-factor.
    Here the spiral in and spiral out are asymmetric.

- Spiral: R and L.


Superelevation
Transition
Spiral-Arc-Spiral
Apply superelevation
Full Superelevation: 5.000 %
Incoming Crossfall: -2.000 %
Outgoing Crossfall: -2.000 %
Transition "automatic"
Curve in
Reverse curve
dS
Chainage
Rate of rotation
Relative grade
NC - TS -17.792 m 171.701 m 2.500 %/sec 0.562 %
HC - TS 0.000 m 189.493 m
FSE - SC 0.000 m 233.973 m 2.500 %/sec 0.562 %
RunOut: 17.792 m RunOff: 44.480 m % Runoff on Arc: 0.000 %
Curve out
Reverse curve
dS
Chainage
Rate of rotation
Relative grade
CS - FSE 0.000 m 260.797 m 2.500 %/sec 0.562 %
ST - HC 0.000 m 305.277 m
ST - NC -17.792 m 323.069 m 2.500 %/sec 0.562 %
RunOut: 17.792 m RunOff: 44.480 m % Runoff on Arc: 0.000 %
OK
Cancel

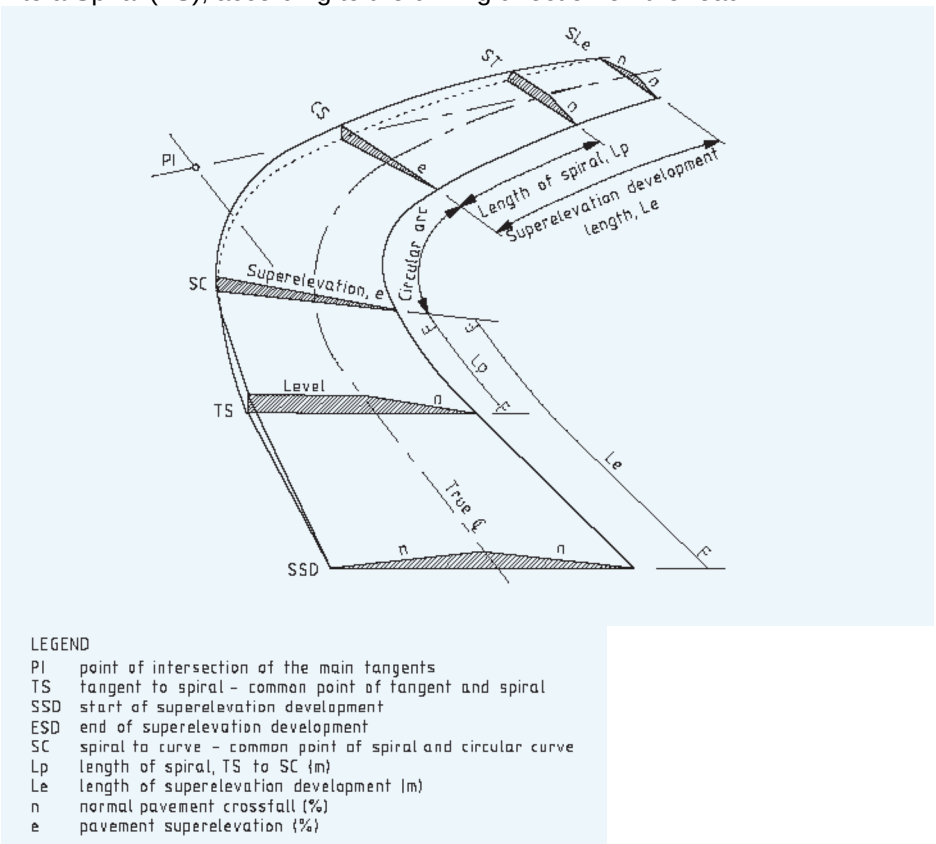
Superelevation

The transition menu is active when 1 intersection point is selected in the plan window.
Superelevation can be applied for the whole road project (See 'Defaults' → 'Road Characteristics' → 'Horizontal transitions') or for every transition individually.

Transition type: Spiral-Arc-Spiral

Incoming crossfall: slope of the normal crown when starting the superelevation process (cross slope of the road).
Outgoing crossfall: slope of the normal crown at the end of the superelevation process (cross slope of the road).
These crossfalls cannot be adjusted in this window. They were defined when the cross section was drawn.

Curve in:
Below are some fields where you can steer the superelevation process. You can indicate the position where the NC should start evolving into HC and FSE. Those positions are relative to the point where the Tangent converts into a Spiral (TS), according to the driving direction on the road.

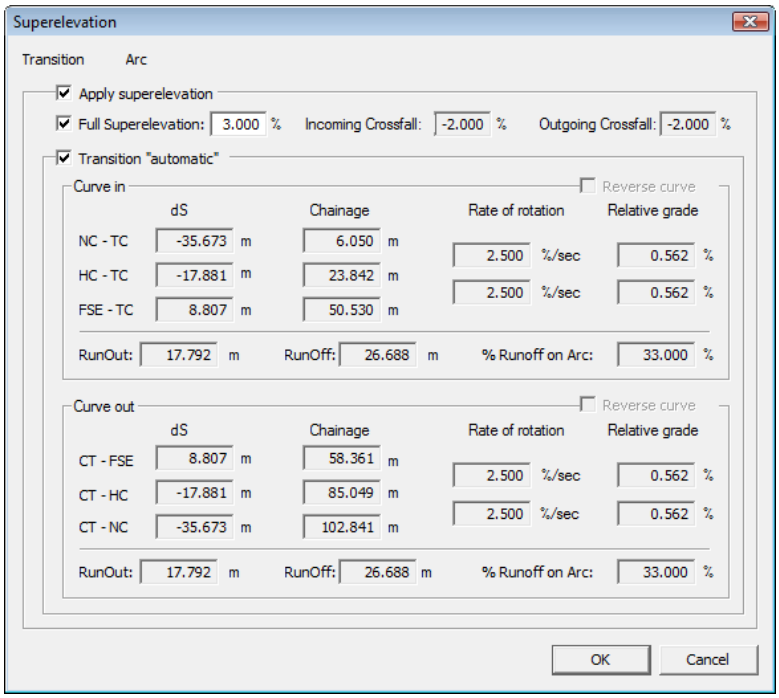


LEGEND

PI	point of intersection of the main tangents
TS	tangent to spiral - common point of tangent and spiral
SSD	start of superelevation development
ESD	end of superelevation development
SC	spiral to curve - common point of spiral and circular curve
Lp	length of spiral, TS to SC (m)
Le	length of superelevation development (m)
n	normal pavement crossfall (%)
e	pavement superelevation (%)

NC – TS: start of superelevation process. Last Normal Crown position relative to point where Tangent changes into Spiral.
dS: enter distance where process should take place, relative to place where tangent becomes spiral (=TS).
NC – TS: -20 m means that superelevation process should start 20 m before TS.
Chainage can be given too, this is a more absolute value.
HC – TS: point where Half Crown should be reached, relative to Tangent to Spiral point.
FSE – SC: point where Full Super Elevation should be reached, relative to point where Spiral changes into Curve.
Curve out:
CS – FSE: point where Full Super Elevation is finished and starts evolving into HC, relative to point where Curve changes into Spiral.
ST – HC: point where HC should be reached, relative to point where Spiral changes into Tangent.
ST – NC: point where NC should be reached, relative to point where Spiral changes into Tangent.

Transition type: Arc


Superelevation
Transition
Arc
Apply superelevation
Full Superelevation: 3.000 %
Incoming Crossfall: -2.000 %
Outgoing Crossfall: -2.000 %
Transition "automatic"
Curve in
Reverse curve
dS
Chainage
Rate of rotation
Relative grade
NC - TC -35.673 m 6.050 m 2.500 %/sec 0.562 %
HC - TC -17.881 m 23.842 m 2.500 %/sec 0.562 %
FSE - TC 8.807 m 50.530 m
RunOut: 17.792 m RunOff: 26.688 m % Runoff on Arc: 33.000 %
Curve out
Reverse curve
dS
Chainage
Rate of rotation
Relative grade
CT - FSE 8.807 m 58.361 m 2.500 %/sec 0.562 %
CT - HC -17.881 m 85.049 m 2.500 %/sec 0.562 %
CT - NC -35.673 m 102.841 m
RunOut: 17.792 m RunOff: 26.688 m % Runoff on Arc: 33.000 %
OK
Cancel

Curve in:
NC – TC: start of superelevation process. Last Normal Crown position relative to point where Tangent changes into Curve.

dS: enter distance where process should take place, relative to place where tangent becomes curve (=TC).

NC – TC: -20 m means that superelevation process should start 20 m before TC.

Chainage can be given too, this is a more absolute value.

HC – TC: point where Half Crown should be reached, relative to Tangent to Curve point.

FSE – TC: point where Full Super Elevation should be reached, relative to Tangent to Curve point.
Curve out:
CT – FSE: point where Full Super Elevation is finished and starts evolving into HC, relative to point where Curve changes into Tangent.

CT – HC: point where HC should be reached, relative to point where Curve changes into Tangent.

CT – NC: point where NC should be reached, relative to point where Curve changes into Tangent.

Those positions are also reflected in the Plan Window and in the Profile Window in Pythagoras.

In the Plan Window:
Transition type: Spiral

Reading from left to right:

The first vertical line indicates the start of the superelevation process (NC).

The second vertical line indicates the point where the Half Crown (HC) position is reached.

The third vertical line indicates the point where the Full Superelevation (FSE) is reached.

The fourth vertical line indicates the point where FSE starts evolving in HC.

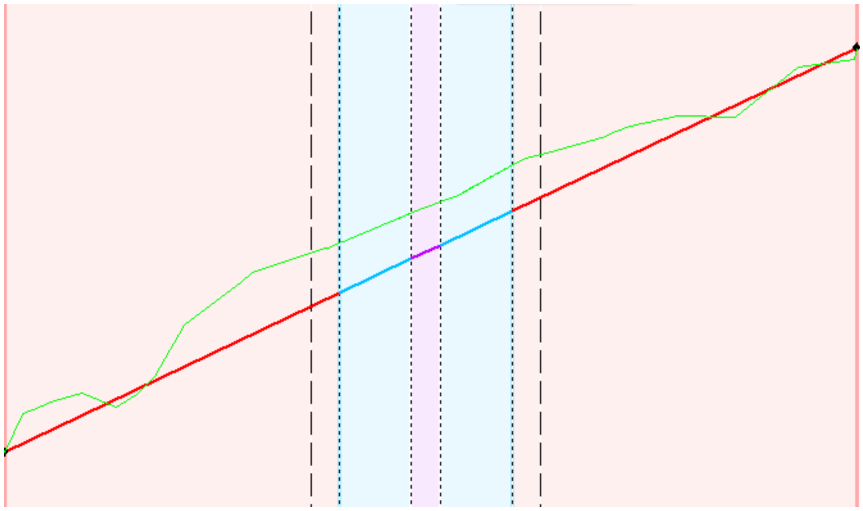
The fifth vertical line indicates the point where HC is reached and starts evolving in NC.

The sixth vertical line indicates the point where NC is reached and the superelevation process is finished.

The first dot indicates the start of the spiral (TS), the second one the start of the arc or curve (SC), the third one the end of the arc or curve (CS) and the last one the end of the spiral/start of tangent (ST).

The upper dot in between SC and CS is the IP: intersection point of tangents.

In the Profile Window:



The dash lines indicate the area of the superelevation process (NC), the dot lines indicate HC, FSE, FSE and HC.
The red line indicates the tangent (straight line), the blue line indicates the spiral, and the magenta line indicates the arc. Corresponding vertical areas are also colorized.

In the Plan Window:
Transition type: Arc

Reading from left to right:

The first vertical line indicates the start of the superelevation process (NC)

The second vertical line indicates the point where the Half Crown (HC) position is reached.

The third vertical line indicates the point where the Full Superelevation (FSE) is reached.

The fourth vertical line indicates the point where FSE starts evolving in HC.

The fifth vertical line indicates the point where HC is reached and starts evolving in NC.

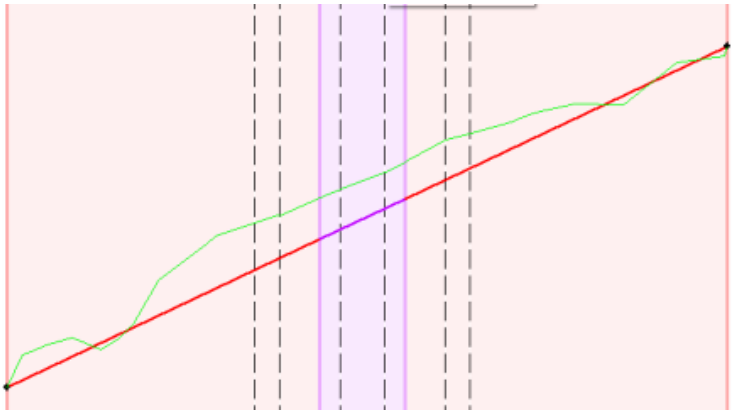
The sixth vertical line indicates the point where NC is reached and the superelevation process is finished.

The first dot indicates the start of the arc or curve (TC) and the other one the end of the arc or curve/start of tangent (CT).

The upper dot in between TC and CT is the IP: intersection point of tangents.

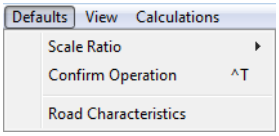
In the Profile Window:

Transition type: Arc



The most left and right dash lines indicate the area of the superelevation process (NC), the other dash lines indicate HC, FSE, FSE and HC.
The red line indicates the tangent (straight line), the magenta line indicates the arc. Corresponding vertical areas are also colorized.

5. Defaults Menu



The Defaults menu allows to set some general defaults for the whole project.

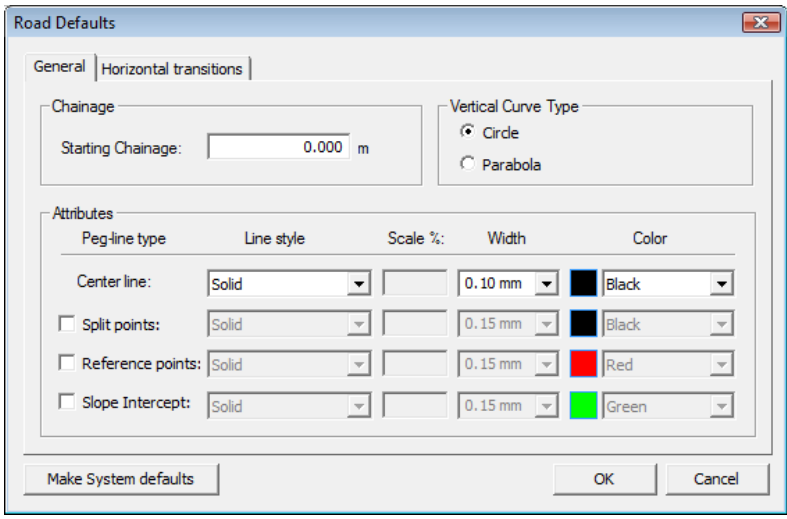
Scale ratio

This setting defines the scale ratio between the x-scale (distance) and the elevation, to exaggerate the elevation.
You can choose a scale from 1/1 to 1/10.

Confirm Operation

If Confirm Operation is "On", Pythagoras will prompt you to enter exact information (distance, height, etc.) when you create an intersection point or a cross section.
When the exact position is not important, you can work faster with Confirm Operation switched "Off".

Road Characteristics



General:

Give starting chainage of road if different to 0.

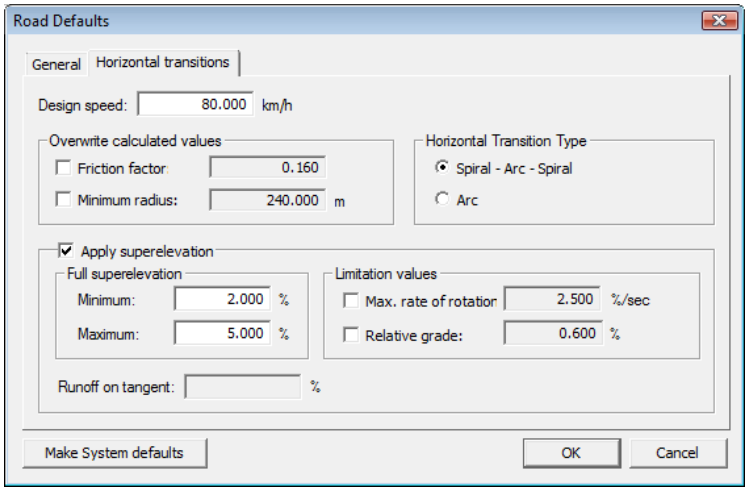
Attributes are used to represent the road in the plan window when you're working in the Road Design module. It is a kind of visualization for your project and the influence of some of its parameters.

To speed up the drawing, zooming and panning processes, the width of the area where Pythagoras tries to connect the project with the existing terrain, is limited to the width of the road x 10.

For example, a road with 2 carriageways of each 4m will be extended till 40m left and right from the centreline. When no connection with the natural terrain can be found within this area, Pythagoras will give up calculating the connection.
'Make system defaults' will store those defaults for the next Pythagoras session.

Horizontal Transitions:

The following formula is used by Pythagoras to define the relation between (1) speed, (2) radius, (3) superelevation and (4) side friction:



$$e + f = \frac{V^2}{127R},$$

where:

e = superelevation,
f = friction factor,
V = design speed,
R = curve radius.

The user must give the design speed and the minimum and maximum superelevation. The parameters "Friction factor" and "Minimum radius" are derived from the design speed and the maximum superelevation.

Friction factor: the default friction factor will depend on the design speed. Pythagoras uses defaults between 0.18 (40 km/h) up to 0.06 (120 km/h). The default values used by Pythagoras are rather conservative. Smaller values ensure adequate safety and give a better driving comfort. The friction factor can be overwritten.

Max. rate of rotation: the maximum rate of rotation is used to calculate the length of superelevation development. The following formula is used:

$$L_{rr} = \frac{0.278(e_1 - e_2)V}{r},$$

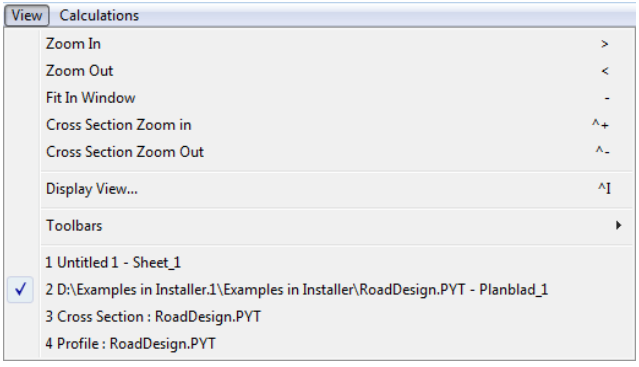
where:

L_{rr} = superelevation development length (m) based on the rate of rotation criterion,
e_1 = normal crossfall (%),
e_2 = full superelevation crossfall (%),
V = operating speed (km/h),
r = rate of rotation (% per second).

Relative Grade: the rate of the longitudinal rise (or fall) of the side of the carriageway, relative to the longitudinal rise (or fall) of the centerline. It is a parameter to reach a comfortable visible effect when driving the road. When type of transition is 'arc', percent of Runoff on tangent will be activated. This is length of transition period to reach FSE, normally 1/3 (runoff) on arc and 2/3 (runout) before arc.

Runoff: the section of the road in which the transition from HC (half crown) to FSE is done.
Runout: the section of the road in which the transition from NC (normal crown) to HC is done.

6. View Menu



The 'View' menu contains menu items, which define, how your drawing is displayed on the graphics screen of your computer.

The toolbox item "Hand" allows you to scroll the page over the drawing in any direction. Press the mouse button on a location of the drawing, move the mouse to its new location on the screen and release the mouse button. The visible area of your drawing will be adjusted accordingly. While moving the mouse, a dashed line shows the direction of the displacement.

The scroll mode can be cancelled by using one of the following keyboard keys: ESC, SPACE bar, Enter.

Remark: A quick key to enter scroll mode is the "+" key on the numeric keyboard.

Zoom In

With the "Zoom In" command you can magnify a part of your drawing on the screen.
When you have selected this command, the shape of the cursor will change to a magnifying glass with a plus sign at the center. Move the cursor to a desired starting location (top left, top right, bottom left or bottom right of the area you want to enlarge), press the mouse button, and move the mouse. A rectangle on the screen will follow the mouse movements. When the rectangle encloses the area of the drawing you want to magnify, release the mouse button.

Remark: You may zoom in with a factor 2 when you just click the mouse button on the position where you want to Zoom In.

Pythagoras supports multiple zoom levels. Each time you zoom in, Pythagoras will remember the previous displayed area and the zoom factor. This information will be used when you zoom out.
You can zoom in up to a maximum of 5 zoom levels.

Remark: Shortcut is ">" key.

Zoom Out

With the Zoom Out command you can reduce the size of your drawing on the screen.
The Zoom Out command will display the area of your drawing using the zoom factor at the previous zoom level.

Remark: Shortcut is "<" key.

Fit In Window

This command will display the complete drawing on the screen.

Remark: Shortcut is "-" key.

Cross section zoom in

This command allows you to zoom in the cross section window while working in another window.

Cross section zoom out

This command allows you to zoom out in the cross section window while working in another window.

Display View

This command allows you to define and select views. Those views decide the content and layout of your drawing (see also PART I → Chapter 2: → Views).

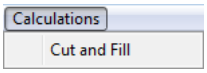
Remark: *Changes in the display view option DTM are not showed in Road Design. In this module only the DTM (with colorized map) is shown that was active at the time Road Design was activated.*

Toolbars

This command allows you to switch on or off some items from the Road Design window:
Road Design: the 3 icons on top of the toolbar to switch between "Plan", "Profile", "Cross Section" Windows.

Road Tools: the drawing and designing tools from the different control panels
Standard: the general Pythagoras toolbar

7. Calculations Menu



The calculations menu allows you to calculate volumes based on your road design project.

Cut and Fill

Before cut and fill can be calculated, the roadbed and the cut and fill parameters of the cross-sections need to be defined:

- Parts that need to be excavated and/or filled.
- Bulking factor.
- Expansion factor.

You can determine the:

- Distance starting point.
- Distance ending point.
- Number of cross-sections.

The distance of the cross-section where you created your roadbed needs to be less than the distance where you start your calculations.
With the "Calculate" button you will start the calculation. When you get the results, you have the possibility to save them as a text file. This file can be opened in 'File' → 'Open text files'.

Following values are stored in the file:

- Number of the cross-section.
- Distance.
- Fill (you will find the totals at the bottom).
- Cut (you will find the totals at the bottom).
- Bulking/expansion factor.
- Corrected cut = cut * bulking or expansion factor.
- Mass haul = fill – corrected cut + upper total.
- Topsoil fill.
- Topsoil cut.

You close the cut and fill calculations dialog by clicking the "Cancel" button.

PART IV Expression Language

In PART I of this manual we already presented a general description of Expressions and their use in Pythagoras (see PART I → Chapter 4: Expressions). In this part you will find a detailed reference on Expression language and instructions on writing your own expressions.

Chapter 1: General Terms

An expression is commonly applied to a CAD object or to a row of a rowset. Some expressions defining a database view are applied to pairs of rows from base rowsets. Thus, expressions are called one- or two-dimensional respectively. The unit of compilation that we are considering here is a single expression.

String to compile

A string to compile is a sequence of Unicode characters. It may not contain any control characters (except final zero).

Lexemes

Lexemes (or tokens) are separated by one or several blank characters from each other. Lexemes may be not separated if they are correctly recognized.

There are the following types of lexemes:
- constants,
- field names,
- function names,
- prefixes,
- operators,
- dot,
- comma,
- parentheses.

Comment is not allowed.

Constants

Constants of the following types are supported:

- Integer numbers: Must be represented as a sequence of digits.
- Real numbers: Must be represented as a sequence of digits with a decimal point inside, before or after. Infinite value can be represented in two ways: as ∞ or as a function call `INFINITY()`.

  To designate integer or real negative values a unary minus can be used, see below.
- Strings: Must be represented within double quotes. If a string contains a double quote inside, it must be repeated twice.

Constants of other types can be represented as function calls with constant arguments or without arguments, for example:

```
TRUE(),DATE(2005,12,15).
```

Field names

Field names are names of columns of a rowset. Field names can be expressed in two ways:

- First way is to use the name as it is; this is possible only when the name is a correct identifier, i.e., it begins with a letter and contains only letters and digits. Characters '$' and '#' are treated as letters and character '_' as a digit.
- Second way is to enclose the name into single quotes. If this name contains a single quote inside, then it must be repeated twice.

Both ways, the letter case is ignored.

Function names

All function names are predefined; see details in the syntax definition below. Letter case is ignored in function names.

Prefixes

In two-dimensional expressions it may be necessary to distinguish between objects of different base rowsets. Special names called *prefixes* are used for this purpose: MAIN for a main and AUX for an auxiliary base.

Separating dot

After a prefix, a dot must be used to separate the prefix from a function or column name.

Operators

All possible operators are described in Syntax section below.

Some operators have two representations: one is more usual, combined from common characters, for example, an inequality can be represented either as ≠ or as <>. The second form is designed to facilitate keyboard input.

Item separator

Item separator (usually comma) is used only to separate list items, for example, actual arguments in a function call.

Parentheses

Left and right parentheses are used in two cases: to enclose item lists and to define order of operations.

Language versions

There are two language versions: localized and international (actually US English).

Localized version is used when you are viewing or editing the sources. International version is used in two cases: in expression strings stored to Pythagoras documents and in expression strings handled via the VBA.

An expression string can be unambiguously converted from one version to another if it is syntactically correct.

Preferences

Compilation is done using Pythagoras preferences, which as a rule coincide with the current preferences. But preferences are stored together with database views, named Finds and Thematic maps and remain untouched. If you change the current preferences or use a named Find with another document, the used preferences may differ from the current ones.

For localized versions, decimal points and item separators in the compiled expression are expected to be as in the preferences (for example, comma ‘,’ as the decimal point and semicolon ‘;’ as the item separator). For international version, dot and comma are assumed respectively.

Some built-in functions get arguments and return results in units set in the preferences. It is supposed that angle unit is not set to so-called survey unit.

Short date and time formats from the preferences are used when converting strings to date and/or time and back.

GermanYX setting in the preferences changes semantics of functions X, Y, XY and YX.

Localization

Function names and prefixes MAIN and AUX are a subject of localization. In a localized version they are obtained from resources, in the international version English names of functions and of these prefixes are used for all localizations. In this document only such function names and prefixes are specified.

Chapter 2: Syntax and semantics

Data types

The following data types are supported:

- Numeric types: integer and real numbers.
- Date and time types: date and time together, date only and time only.

  Date and time together (referenced further as date-time) has moments of time as values. They may be interpreted as UTC or as local time.

  Date only (referenced further as date) is a type whose values are dates.

  Time only (referenced further as time) is a type with time durations as values. They may be interpreted as the time of day, the value is non-negative and equals to the time duration from the beginning of the day to the described moment. The other interpretation is the time interval between two moments, the value may be negative.
- String type: Unicode strings.
- Boolean type: TRUE() and FALSE() (function calls).
- Graphic object type: graphic objects of the current document.
- Coordinate type: only XY is supported.
- Graphic object type: POINT(), LINE(), POLYGON(), TEXT(), ARC(), CIRCLE(), SPLINE(), PATH(), IMAGE(), CLOTHOID(), RICHTEXT(), ROAD() and COMPOUND() (function calls).

Type coercion

Only two cases of implicit type coercion are supported: integer to real and date to date-time. In the second case, time of day is assumed to be 0 hour (beginning of the day).

NULL value

A special NULL value may occur either as a term or as a value of an expression (subexpression). NULL value is compatible with every type.

NULL as an error signal

The result of any operation or function where at least one argument is NULL is also NULL. This rule has few exceptions described explicitly below. The

result of an operation or function can be also NULL if it cannot be calculated, for example, Date(2005,2,30) (30th of February).

Function NULL()

The function call NULL() always returns the NULL value. It may be used as the NULL constant value. Sometimes it is necessary to specify the NULL constant value explicitly, see an example in Chapter 5: Examples.

Empty string and NULL values

In most RDBMSs including all versions of the SQL standard empty strings and NULL values are treated differently. But in other databases and in many other cases (CSV and DBF files) they are not distinguished. One of the reasons for this is that both values are intuitively treated as identical by many users.

Empty strings and NULL values are indistinguishable in Pythagoras expression language. Particularly, a value of a column of string type is never obtained as NULL. It is an empty string in any case, independent of whether it is actually an empty strings or a NULL value.

Comparison operations

All comparison operators return Boolean values.

Less/greater

Expressions of the following types can be compared:
- all numeric,
- all date and time,
- string.

Both operands must be of the same type except integer-real and date/time-date combinations. The following comparison operators are available:
‘<’, ‘≤’ (or ‘<=’), ‘>’, and ‘≥’ (or ‘>=’).
Order between strings is assumed to be alphabetic case insensitive in the current locale.

Equality/inequality

Expressions of all types can be compared. Both operands must be of the same type except integer-real and date/time-date combinations. The following comparison operators are available:
‘=’ and ‘≠’ (or ‘<>’).

String operands are assumed to be equal when they differ only by letter case in the current locale.

Note that ‘NULL = NULL’ equals to NULL. To compare a value with NULL, a special function ISNULL() is used.

Arithmetic operations

Unary minus

The '–' (minus) sign is used before an integer or real expression to negate its value.

Addition

The '+' (plus) sign is used between expressions to add their values. The following type combinations are possible:

Left operand type	**Right operand type**	**Result type**	**Comment**
integer	Integer	integer	
integer	Real	real	
real	Integer	real	
real	Real	real	
date-time	Time	date-time	
date	Time	date-time	
time	date-time	date-time	
time	Date	date-time	
time	Time	time	
date	Integer	date	integer value is the number of days
integer	Date	date	integer value is the number of days

Subtraction

The '–' sign is used between expressions to subtract their values. The following type combinations are possible:

Left operand type	**Right operand type**	**Result type**	**Comment**
Integer	integer	integer	
Integer	real	real	
Real	integer	real	
Real	real	real	
date-time	date-time	time	
date-time	date	time	
Date	date-time	time	
date-time	time	date-time	
Date	time	date-time	
Time	time	time	
Date	integer	date	integer value is the number of days
Date	date	integer	integer value is the number of days

Multiplication

The '*' (asterisk) sign is used between expressions to multiply their values. The following type combinations are possible:

Left operand type	Right operand type	Result type
Integer	integer	integer
Integer	real	real
Real	integer	real
Real	real	real
Time	integer	time
Time	real	time
Integer	time	time
Real	time	time

Division

The '/' (slash) sign is used between expressions to divide left value by the right one. The following type combinations are possible:

Left operand type	Right operand type	Result type
integer or real	integer or real	real
time	integer	time
time	real	Time

String concatenation

The '&' sign may be used between string expressions to obtain string concatenation.

Chapter 3: Functions

Function calls

Pythagoras expression language supports only embedded functions. Each function is distinguished by a unique name.

A function call has the syntax

name (*arg1*, *arg2*,…, *argN*),

where *name* is a function name (keyword). Number of arguments in parentheses is arbitrary; parentheses are necessary even when there are no arguments.

Prefixing

In two-dimensional expressions prefixes can be used to define one of two dimensions. They must be followed by a separating dot and then by a column name or a function call.

Only functions which depend on dimensions can be prefixed:

- OBJECT(),
- object feature functions with omitted arguments
- aggregate functions.

See also Chapter 4: → Determining main or auxiliary rowset below.

Type conversions

Implicit type conversions are functions with names equal to types and mostly with one argument (there is one exception). The following conversions are possible:

Function name	**Argument(s) type(s)**	**Comment**
INTEGER	date	As days
INTEGER	string	
REAL	integer or string	
REAL	date-time, date or time	As days
DATETIME	real	As days
DATETIME	date	
DATETIME	string	*
DATE	integer	As days
DATE	string	*
TIME	real	As days
TIME	string	*
STRING	integer	

STRING	real and integer	a real is converted and represented with number of decimal places equal to an integer
STRING	date-time	*
STRING	date	*
STRING	time	*
STRING	Boolean	TRUE—Y, FALSE—N

Conversions are made using short date and time format strings from the current preferences.

All these functions can be also applied to an argument already having the desired type – in this case they merely return the value of the argument.

Special functions are used to convert real to integer: TRUNC and ROUND. The first one converts to the nearest integer value less or equal by the absolute value, the second one converts to the nearest integer value.

In all conversions of strings the letter case is ignored. In real–string conversions a decimal separator defined in the current preferences is used.

Unit conversion

The following functions return specified units:
MM(), CM(), DM(), M(), DAM(), HM(), KM(), INCH(), FOOT(), USFOOT(), MILE(), GRAD(), DEGREE(), MIL() and RADIAN.

To convert linear length or angle values, you can multiply or divide by these constants:

- If columns HEIGHT and VOLUME contain values expressed in meters and cubic kilometers respectively, these values can be expressed in a length unit from the preferences as HEIGHT*M() and VOLUME*CUBE(KM()).
- Elevation of the current graphic object can be expressed in meters as Z()/M().
- To express HEIGHT in miles, use the expression HEIGHT*M()/MILE().

The above functions can also have one argument of type real. In this case, the argument value is divided by the corresponding constant. The latter examples can be rewritten respectively:

- KM(KM(KM(VOLUME))) (not recommended);
- M(Z());
- MILE(HEIGHT*M()).

XY assembler and disassemblers

Functions XY and YX accept two real arguments each and return an XY value. Functions X and Y accept an XY argument and return a real value expressed in length unit from the preferences.

All these functions are GermanYX setting dependent. On the contrary, functions EN, NE, E and N (east and north) are GermanYX setting independent.

Comparison functions

The following functions return Boolean values. Comparison is case insensitive.

Function name	Arguments number and type	Meaning
BETWEEN	three arguments *e*, *a*, and *b* of the same type; type must be admissible for ≤ comparison	$e \geq a$ and $e \leq b$
IN	two or more arguments of the same type except Boolean	first argument is equal to one of other ones
LIKE	two arguments *s* and *p* of string type	see text below
STARTS	two arguments *s* and *p* of string type	*s* begins with *p*
ENDS	two arguments *s* and *p* of string type	*s* ends with *p*
CONTAINS	two arguments *s* and *p* of string type	*s* contains *p*
ISNULL	one argument of any type	result is TRUE when an argument has value NULL or is an empty string

The function LIKE returns TRUE if the compared strings correspond in the following sense:

- a special value ANYSEQ() in p corresponds to any sequence of characters in s (including an empty sequence),
- a special value ANYCHAR() in p corresponds to any character in s,
- other characters in p must correspond to the same characters in s.

See an example of function ISNULL in the description of the Function IF.

Logical functions

Logical functions have arguments and results of Boolean type.

Function name	Number of arguments
NOT	one
AND	two or more
OR	two or more

- If at least one of AND operands is FALSE, the result is also FALSE, even if some of the other operands are NULL.
- If at least one of OR operands is TRUE, the result is also TRUE, even if some of the other operands are NULL.

Function IF

This function has three arguments, the first one must be of Boolean type and the other arguments must be of compatible types. The type of the result is defined by the types of the last two arguments:

Arguments types	Result type
integer and/or real	integer if both arguments are integers; real otherwise
date and/or date-time	date if both arguments are dates; date/time otherwise
any other type (same for both arguments)	the same type

If the first argument is TRUE, then the second argument is regarded as the function result; if the first argument is FALSE, then the third argument is regarded as the function result.

Example: *We have an attribute table containing data about some parcels. Column 'Price' contains the known price of a parcel or NULL if the price is unknown. We want to write down an expression containing the supposed price of a parcel: if the price is unknown, then this price is calculated as the area of the parcel multiplied by 212 (supposed price of 1 area unit). The expression will be*

*if (isnull(price), area() * 212, price)*

Function COALESCE

The function COALESCE has one or more arguments. Types of all arguments must be compatible in-between themselves. Type of the result is defined in the same way as for the IF function above.

The result of this function is the first argument value being neither NULL nor an empty string. If every argument value is either NULL or an empty string, then the result is an empty string if at least one of the arguments is an empty string, and NULL otherwise.

This function is useful to substitute NULL by some other values. The example for the IF function above can be rewritten simpler:

*coalesce (price, area() * 212)*

Functions MINIMUM and MAXIMUM

These functions have one or more arguments. Types of the arguments and of the result are described in the following table:

Arguments types	Result type
integer and/or real	integer if all arguments are integers; real otherwise
date and/or date-time	date if all arguments are dates; date/time otherwise

time	time
string	string

Note: *Names of these functions in version 11 of Pythagoras were MIN and MAX. They have been changed because a new aggregate functions MIN and MAX were introduced (see below). This must be taken into account when reading/writing Pythagoras v11 documents.*

Numeric functions

All numeric functions have only one argument; type of the argument must be the same as the expected result type. Functions with real result may be also applied to an integer argument.

Function name	**Result type**
ABS	integer, real or time
SQUARE	integer or real
SQUAREROOT	real
CUBE	integer or real
EXP	real
LOG	real
SIN	real
COS	real
TAN	real
ASIN	real
ACOS	real
ATAN	real

Functions SIN, COS and TAN get values and functions ASIN, ACOS and ATAN return values in angle units set in the preferences.

Date/time functions

There are two functions without arguments:

Function name	**Result type**	**Comment**
NOW	date-time	UTC time is returned
TODAY	date	local date is returned

Also there are some functions with one argument:

Function name	**Argument type**	**Result type**	**Comment**
UTCTOLOCAL	date-time	date-time	
LOCALTOUTC	date-time	date-time	
DATE	date-time	date	
TIME	date-time	time	time of day
YEAR	date-time or date	integer	
MONTH	date-time or date	integer	January = 1
DAY	date-time or date	integer	day of month
DAY	time	integer	number of full days
HOUR	date-time or time	integer	0÷23
MINUTE	date-time or time	integer	0÷59
SECOND	date-time or time	integer	0÷59

The following functions compose date and time values:

Function name	Arguments meanings and types	Result type	Comment
DATETIME	date and time	date-time	
DATETIME	year, month, day, hour, minute and second, all integers	date-time	arguments may be omitted beginning from hour
DATE	year, month and day, all integers	date	
TIME	day, hour, minute and second, all integers	time	the argument day is the number of full days; arguments may be omitted beginning from hour

String functions

Function name	Arguments meanings and types	Result type	Comment
LEN	string	integer	
LEFT	string and length(integer)	String	- left substring of specified length; - if the specified length is greater than the actual length, the whole string is returned
RIGHT	string and length(integer)	String	- right substring of specified length; - if the specified length is greater than the actual length, the whole string is returned
MID	string, position(integer) and length(integer)	string	- substring beginning from specified position of specified length; - positions are numerated from 1; - if the specified position is greater than the actual length, an empty string is returned; - if the specified length is too big, then a shorter string is returned
LTRIM	string	string	eliminate all blanks from the beginning of the string
RTRIM	string	string	eliminate all blanks from the end of the string
TRIM	string	string	eliminate all blanks both from the beginning and the end of the string
UPPER	string	string	
LOWER	string	string	
UNICODE	string	integer	Unicode code of the first character of the string
CHAR	integer	string	returns a string with one character with the Unicode code equal to the argument value

Function OBJECT

To reference a graphic object itself, build an expression with a special function OBJECT(). For example, an expression OBJECT()=NEXT can be used to check whether a value in the column NEXT references the object.

Graphic object features

The functions returning graphic object features always have a single argument – the graphic object they are applied to. If the argument is omitted, it is interpreted as applying the function to OBJECT():

- Both COORDINATES(OBJECT()) and COORDINATES() return coordinates of the object.
- But both COORDINATES(NEXT) and COORDINATES('NEXT') return coordinates of an object referenced in the column NEXT of a rowset.

If the function name is preceded by a prefix, the argument must be omitted, and the argument *prefix*.OBJECT() is assumed:

- Both AUX.COORDINATES(OBJECT()) and COORDINATES(AUX.OBJECT()) return coordinates of the object of the auxiliary base rowset.
- But both COORDINATES(AUX.NEXT) and COORDINATES(AUX.'NEXT') return coordinates of an object referenced in the column NEXT of the auxiliary base rowset.

Some functions are meaningful only for graphic objects of certain types. Being applied to graphic objects of improper type, they return NULL.

Distances, areas and angles are assumed to be in units specified in preferences.

Function name	**Object types**	**Result type**	**Value for compound**	**Comment**
TYPE	all	object type	COMPOUND()	
CONTAINER	all	object type	NULL	for compound element the compound is returned; otherwise NULL is returned
COMMENT	all except text, rich text and compound	string	NULL	not NULL except text, rich text and compound
DISPLAYLEVEL	all except compound	integer	NULL	
LAYER	all except compound	string	an empty string	
SELECTED	all except compound	Boolean	NULL	
FLAGGED	all except compound	Boolean	NULL	
POINTNUMBER	point	string	an empty string	
XY	point, text or rich text	XY	NULL	synonyms YX, EN and NE may be also used
X	point, text or	real	NULL	GermanYX dependent

	rich text			
Y	point, text or rich text	real	NULL	GermanYX dependent
E	point, text or rich text	real	NULL	GermanYX independent, synonym RW may be also used
N	point, text or rich text	real	NULL	GermanYX independent, synonym HW may be also used
Z	point	real	NULL	
LENGTH	line, arc, circle, spline, clothoid, path or compound	real	sum of values for all lines, arcs, circles, splines, clothoids and paths	
PERIMETER	polygon or compound	real	sum of values for all polygons	
BEARING	line	real	NULL	
DELTAZ	line, arc, spline, clothoid or path	real	NULL	
SLOPELENGTH	line, arc, circle, spline, clothoid, path or compound	real	sum of values for all lines, arcs, circles, splines, clothoids and paths	For splines length is calculated now instead of slope length
SLOPEPERIMETER	polygon or compound	real	sum of values for all polygons	
STARTINGPOINT	line, arc or clothoid	graphic object	NULL	
ENDPOINT	line, arc or clothoid	graphic object	NULL	
RADIUS	arc or circle	real	NULL	
APERTURE	arc	real	NULL	
CENTER	arc or circle	XY	NULL	
MINZ	spline	real	NULL	
MAXZ	spline	real	NULL	
CONTENT	text or rich text	string	NULL	
AREA	polygon or compound	real	sum of values for all elements being polygons	

Pythagoras specific functions

Function name	First argument	Second argument	Result type	Comment
DISTANCE	XY or graphic object of one of the following type: point, line, polygon, arc, circle, spline, path, clothoid, compound	XY or graphic object of one of the following type: point, line, polygon, arc, circle, spline, path, clothoid, compound	real	this function returns NULL when one of arguments is a spline other than a broken line or a compound containing such spline
INSIDE	XY or point	graphic object (polygon or compound)	Boolean	a point lies inside the specified polygon or inside a polygon being an element of the specified compound

Aggregate functions

Aggregate functions differ from the others in the way that they are applied not to one row (object) but to an entire rowset. A subexpession being an argument of an aggregate function is calculated for each row, and then the function is applied to all values.

Function name	Argument type	Result type	Comment
`COUNT`	no argument	integer	number of rows
`MIN`	numeric, date, time, date/time or string	the same	minimal value
`MAX`	numeric, date, time, date/time or string	the same	maximal value
`SUM`	integer, real or time	the same	sum of values
`AVG`	integer, real or time	time for time, real otherwise	`SUM(…) / COUNT()`

- COUNT and SUM return 0 when applied to an empty rowset, others return NULL.
- If a subexpression value is NULL at least for one row, the result of SUM and AVG will be also NULL.
- For AVG, the function value is also NULL when the rowset is empty, i.e. contains no rows.
- For MIN and MAX functions, the result is the minimum (maximum) value of all non-NULL values. If all subexpression values are NULL or the rowset is empty, then MIN and MAX functions also return NULL.

Chapter 4: Expression Kinds and Compilation

Target expressions

We will call *target* expressions the ones used as final expressions as opposed to the expressions building views. You use target expressions in the Find dialogue to search for a set of objects or in thematic maps to range objects.

Expression kinds

From the point of view of syntax and semantics we have to distinguish between five kinds of expressions.

1. One-dimensional expression without aggregate functions

This is the most common expression kind. An expression is applied to one rowset and does not use aggregate functions. For example:

- where expressions for simple views;
- target expressions in Find dialogue.

2. One-dimensional expression with aggregate functions

An expression is applied to one rowset and can use aggregate functions applied to the same rowset. For example:

- column expressions for simple views;
- target expressions in Thematic maps.

3. Match expression in aggregation views

An expression is applied to two rows belonging to different rowsets. They cannot use aggregate functions.

4. Where expression in aggregation views

An expression is applied to a row and a rowset; the row belongs to other rowset than the argument. Only aggregate functions applied to the second dimension can be used.

5. Column expression in aggregation views

An expression can reference only objects and columns of the main dimension. Aggregate functions of both dimensions can be used but have very different meanings.

An aggregate function applied to the auxiliary dimension is applied to all rows of the auxiliary base rowset corresponding to the current row of the main rowset. An aggregate function applied to the main dimension is applied to all rows of the main base rowset.

Determining main or auxiliary rowset

In aggregation views, columns and objects of two dimensions are present in expressions. Mentioned above prefixes Main and Aux can be used to indicate the dimension.

In some cases such indication is unnecessary. For example, if only one base rowset is an attribute one, then the function OBJECT() can be applied only to this dimension; if the referenced column is present only in one base rowset, etc.

In all cases of ambiguity there are default values:

- Inside an aggregate function applied to an auxiliary dimension call this dimension is assumed.
- If an aggregate function is called in a column expression of an aggregation, the auxiliary dimension is assumed.
- In all other cases the main dimension is assumed.

Expression compilation

Each expression is entered in textual form and needs to be compiled. Expression compilation is provided at the moment depending on its kind and many other factors.

Of course, compilation can be successful or not. In case of failure, you will be provided with a description of lexical or syntax errors, and in most cases the part of the expression that caused the error will be highlighted.

Chapter 5: Examples

One-dimensional expressions

Without aggregate functions

Find example

Find all graphic objects, where comments contain the substring "*electr*" (in any letter case):

like (comment, anyseq() & "electr" & anyseq())

Find using database

Find all graphic objects connected to an attribute table and having in column Completion a date between 2006-01-01 and 2006-03-15:

between (completion, date(2006,1,1), date(2006,3,15))

Find using IF function

Find all points, where comments begin with the percentage ('%') sign, and all other objects, where this sign is in the second position:

if (type=point(), like(comment,"%"&anyseq()),
like(comment,anychar()&"%"&anyseq()))

Using NULL function

We have an attribute table describing parcels. The table has columns *Price* and *PriceDate* containing respectively price estimate and the date when this estimation was made (or two NULL values if the price is unknown). We want to calculate the most trustable price. If the price in the database is not older than 5 years we will recalculate it assuming inflation level of 3% per year. Otherwise, we will return NULL because we have no trustable price. This task can be solved as following:

*if (real(now()–pricedate) < 5*365, price * exp (real(now()–*
*pricedate) / 365 * log(1.03)), null())*

Note that this expression gives a correct result also in cases when either *Price* or *PriceDate* is NULL:

- If the value in *Price* is NULL, the second argument of the IF function is calculated to NULL, and therefore, the result is also NULL.
- If the value in *PriceData* is NULL, the first argument is calculated to NULL, and therefore, the result is also NULL.

Using aggregate functions

Table view

We have an attribute table *Roads* linked to paths and having a column *Width*. We want to find all roads at least 10 m wide and display their lengths and widths. We also want to see the total length of all such roads.
The main rowset is, of course, the *Roads* table. A *where* expression can be defined as

*width ≥ 10*m()*

Column expressions can be defined as

length()
width
sum(length())

The second column can be defined as ordering in the descending order.

We will obtain a rowset containing three columns. All roads are sorted by their widths in ascending order. The first two columns are length and width; the third column contains the total length being the same value for all rows.

Aggregations views

Find using an aggregate function

We have the same table *Roads* as in the example above and an attribute table *GasStations* linked to points. We want to find roads with more than 1 gas station per km.

First of all let us define a view to be used in the Find dialog. The main rowset is the *Roads* table, the auxiliary rowset is the *GasStations* table. The *match* expression can be defined as

*and (aux.Propane, distance (object(), aux.object()) ≤ 100*m())*

Here *Propane* is the name of a column of Boolean type, i.e., we are searching only for gas stations, where propane refueling is possible. The first time the function *object()* is unprefixed; this means that the main rowset object is assumed (default). The *where* expression can be defined as

true()

This means that all roads are included into the new view. Column expressions are absent; we need no columns in the new view. The Find dialog references the created view. The *target* expression is

count() / km(length()) > 1

Find using telescope

The previous example has a serious drawback. To build a match lattice, all row pairs of the tables *Roads* and *GasStations* will be searched through. But

actually, very few gas stations have the propane option – it would be faster to find all such stations first.

We will solve the task in two steps:

1) Build a simple view *PropaneStations* containing only gas stations with the propane option. The base rowset is the table *GasStations*. The *where* expression is *Propane*. No column expression is necessary.

2) The second step is close to the example above. The main rowset is also the *Roads* table, the auxiliary rowset is the *PropaneStations* view. The *match* expression is

*distance (object(), aux.object()) ≤ 100*m()*

The *where* expression is also true(). The further actions are as in the example above.

Table view using aggregate functions of both kinds

Continuing previous examples, we want to build the same view but extended by two new values: number of filling stations per km for each road and in total.

The main rowset is the *Roads* table, the auxiliary rowset is the *PropaneStations* view. The *match* expression is

*distance (object(), aux.object()) ≤ 100*m()*

The *where* expression is

*width ≥ 10*m()*

Column expressions are:

km(length())
width
km(main.sum(length()))
count() / km(length())
sum(count()) / main.sum(km(length()))

Note that *main.* is necessary twice. Otherwise, the expression *sum(km(length()))* would mean an absolutely different and strange thing: the total length of all filling stations close to the current road. As filling stations are points, their length is calculated as NULL and this expression would be calculated to NULL also.

Appendices

Appendix A: Coordinate List Format

A coordinate list is a text-file containing the point number, and the coordinates of a number of points. In PART II → Chapter 1: → Import/Export it is explained how Pythagoras uses this text file.

A coordinate list can be made with almost any word processor or with spreadsheet programs (Microsoft Excel, Lotus 123, etc.).

A coordinate list has the following structure:

<PointId> TAB <Coord1> TAB <Coord2> TAB <Coord3> TAB [<InstrH>] TAB [<ReflH>] TAB <Comment>

The coordinates can be:

- XYZ
- NEZ
- HDZ
- HVD
- HVS

The separator-symbol can be either TAB, space, comma or semi-colon (;).

Appendix B: Shortcut Keys

To activate menu items, Pythagoras supports the shortcut keys which are standardized on Microsoft Windows. Consult the user manual of the system you have if you want to learn more about the standard use of shortcuts.

Besides the standard menu shortcut functions, you may use a number of Pythagoras shortcut keys to do some operations faster.

Note that the ALT and the CTRL have the same functionality.

Important remark!:
When using the CTRL-, ALT- or SHIFT key, those keys must remain pressed until the operation is completed.

Key	Function
ALT or CTRL key	

a) In Select mode:

When the CTRL key is pressed when selecting a line or arc, also the endpoints of the line or arc will be selected.

When the CTRL key is pressed when you drag text, the text will be duplicated. The CTRL must only be pressed when you release the mouse button.

b) While creating text:

When you mouse the text cursor over the screen while the CTRL-key is pressed, the text cursor will snap to lines, arcs and points.

c) While drawing lines:

When pressed during line drawing, the new line will remain parallel to the X-axis or the Y-axis of the active coordinate system.

d) Drawing circle or arc with given center and radius:

When pressed when you confirm the circle, a point at the center of the circle will be created.

e) Drawing arc tangent to two lines:

When the CTRL key is pressed when you confirm the tangential arc, the lines are trimmed or extended up to the points of contact.
This is a shortcut for the "Fillet" command.

f) If in the mode "Dimension" the CTRL-key is held down, Pythagoras will temporarily go to the mode "User Coordinate

System". By clicking subsequently the origin and the direction of a baseline, Pythagoras will create a temporary coordinate system and the program will return to the mode "Dimension". This feature is useful for quickly creating XY-dimensions relative to a baseline.

g) Creating a temporary coordinate system parallel to the current CS:

When the CTRL key is pressed when you click on the origin of a new CS, a temporary coordinate system is created.
The axes of the newly created coordinate system are parallel to the active coordinate system.

h) Creating a temporary coordinate system:

When the CTRL key is pressed when you click on the point indicating the direction of the new coordinate system, a temporary coordinate system is created.

i) Move command:

When the CTRL key is pressed when moving objects, the objects can only be moved parallel or perpendicular to the active coordinate system.

j) Join command:

When the Join command is executed, the original endpoint of the line or arc is not cleared.

k) Setting active layer in the control panel.

Holding the CTRL key when a layer is made active, the selected objects will be moved to the active layer.

l) Parallel line segment.

Holding CTRL key when confirming distance. Pythagoras will construct a rectangle. The height is the distance of the parallel line to the reference line. The rectangle consists of separate lines.

m) Selection of 'Library Symbol' or 'Document Symbol' in the menu 'Defaults'

Holding the CTRL key when the default symbol is selected, the program will automatically come in the mode "Draw Symbol".

n) During rotation of objects

When the CTRL-key is pressed while you rotate selected objects, the angle of rotation will be a multiple of 90 degrees.

o) When you make the Page Coordinate System active while you keep the CTRL-key down, the selected objects will be transformed to page coordinates.

p) When you make the Local Coordinate System active while you keep the CTRL-key down, the selected objects will be transformed to local coordinates.

q) By holding the CTRL-key down during the confirmation of the creation of a point on a line, the line is automatically split in 2 parts. The created point becomes the endpoint of the first line, and the starting point of the second line.
The properties of the original line remain.

r) Holding the CTRL-key down and hitting the T-key pops up the Thematic Maps Manager.

s) Holding the CTRL-key down and hitting the I-key pops up the Display View dialog box.

SPACEBAR

a) Toggles between "Select" mode and the last used toolbox mode.

b) Line mode

The line will convert in an arc tangential to the line that was seen on the drawing before the SPACEBAR was pressed.

c) Creation rotatable symbol

When the default point style is a rotatable symbol, and you define a point, you first need to click the cursor on a line to indicate the angle of the symbol. Press the SPACE-BAR if you want to rotate the symbol over 180°.

SHIFT key

a) In Select mode:

When the SHIFT key is pressed, you can add or delete objects from the selection.

b) While drawing lines:

Clicking the mouse on the endpoint of a line, while the SHIFT key is pressed, will start drawing of a new line starting from the same endpoint. This way you can draw lines connecting multiple existing points faster.

c) When drawing parallel line segments.

Press the SHIFT key and move the cursor over an adjacent line or arc. The result is the same as the creation of a parallel polyline to a path.

Shift Lock / Caps Lock

When "Point Confirmation" is switched on, Pythagoras will automatically request exact information to locate the new object you want to create. When the Shift Lock or Caps Lock key is down, you activate repetitive entry of data. This means that the program remains in confirm mode after confirmation of data. Using this feature, you may for example quickly generate points on a line.

">" key

Will activate Zoom In
(same as selecting "Zoom In").

"<" key

Will activate Zoom Out
(same as selecting "Zoom Out").

"=" key

Will select "Actual Size".

"-" key

Will select "Fit in Window".

TAB key

a) During input in the control panel:

Will move to the next field in the control panel.

b) In most drawing modes when the cursor is on a line.
The control panel will show subsequently:

- the line length,
- the slope length,
- the elevation,
- the bearing,
- the gradient.

c) In most drawing modes when the cursor is on an arc.
The control panel will show subsequently:

- the length of the arc,
- the radius,
- the angle at the center,
- the slope length,
- the elevation,
- the gradient.

Shift-TAB keys

If certain information about the object has been chosen, the SHIFT-TAB combination will make this the default information of that kind of objects as long as you don't quit Pythagoras.

ESC key

Cancels drawing operations. Has the same effect as re-selecting the toolbox function.

"0".."9" keys

Used to find the point on a line or arc at intervals of 1/2 .. 1/19 of the length of the line or arc.
When the numeric key (or keys) are pressed during the creation of points, lines, arcs or circles, the cursor will snap to the points at the requested interval.
"2": interval 1/2, "3": interval 1/3, ... "9": interval 1/9, "0": interval 1/10, "1": interval 1/11, "1" and "2": interval 1/12, "1" and "9": interval 1/19.

"T" key

If pressed down, only text will be selected while creating a selection window with the cursor. All other object types inside of the window will not be selected.

"P" key

If pressed down, only points will be selected while creating a selection window with the cursor. All other object types inside of the window will not be selected.

"O" key

If pressed down, only polygons will be selected while creating a selection window with the cursor. All other object types inside of the window will not be selected.

"X" key

If pressed down, only paths will be selected while creating a selection window with the cursor. All other object types inside of the window will not be selected.

"R" key

If pressed down, only roads will be selected while creating a selection window with the cursor. All other object types inside of the window will not be selected.

"L" key

If pressed down, only lines will be selected while creating a selection window with the cursor. All other object types inside of the window will not be selected.

"I" key

If pressed down, only images will be selected while creating a selection window with the cursor. All other object types inside of the window will not be selected.

"B" key

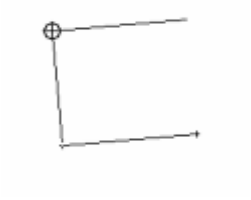
If pressed down, only images will be selected while creating a selection window with the cursor. All other object types inside of the window will not be selected.

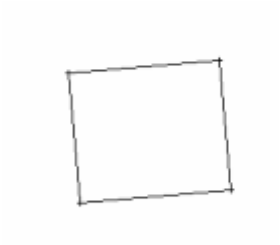
"A" key

If pressed down, only arcs will be selected while creating a selection window with the cursor. All other object types inside of the window will not be selected.

"G" key

This key is used to convert a non perpendicular angle into perpendicular and to create a square based on the length of the both sides. Select the offset tool and click on the base line (the one who needs to maintain its direction), snap to the other line, press "G" key and move the cursor. The perpendicular situation will be constructed. Click anywhere in the drawing and the square will be closed automatically.





DEL - BACKSPACE

a) Same as the menu command "Clear".

b) While creating a polygon:

The last object of the polygon will be removed.

Double click

a) During the creation of a path or polygon.

Double click on line or arc: adjacent lines and arcs are added to the polygon or to the path until a junction is encountered or until there are no adjacent lines.

b) In selection mode

CTRL - SHIFT - Double click:
the attributes of the object will become the new defaults.
(E.g. For text: size, width, style, alignment)

SHIFT - Double click:
the attributes of the object will be changed to the actual defaults.

The combination of the 2 previous shortcuts allows you to quickly assign the attributes of an object on the drawing to another object.

CTRL - Double click on a point:
The elevation (Z) of the point can be changed in the control panel.

CTRL - Double click on a text:
The text will be rotated over 180 degrees.

c) Join function

When you click once on the second object, only the first will be trimmed or extended. But when instead you double click on the second object, also the second object will be trimmed or extended.

d) During the creation of a perpendicular line, parallel line, parallel path, object text. When you double click on the reference object, the reference object remains selected after

the creation of the object.
The selection is removed by using the ESC key or the SPACEBAR.

e) When double clicking on a line, it is possible to check the 'Turn around' box. This mirrors the line style. It is quite obvious with asymmetric line styles.

Middle mouse button

a) Double click

Same as the menu command "Fit in Window".

b) CTRL - Double click

If no link to an external file exists yet:
Same as the menu command "Choose External File".

If a link to an external file already exists:
Same as the menu command "Open External File"

Appendix C: Place Holders

Place holders can be used in a Pythagoras text field (not in a Rich text field). Specific information will be filled-out in place of the place holder, depending on the place holder that is used.

Overview

^s: is the place holder for "scale"

^d: is the place holder for "date"

^f: is the place holder for "file name"

^p: is the place holder for "sheet name"

^u: is the place holder for "user name"
This name corresponds with the user name used to log on in Windows.

^c1: is the place holder for "the X coordinate of the bottom left printable part of a sheet"

^c2: is the place holder for "the Y coordinate of the bottom left printable part of a sheet"

Appendix D: PYTHAGOR.INI file settings

The file Pythagor.ini is located in the C:\Windows folder (not in the Pythagoras folder)

MAXIDS

The maximum number of objects in a drawing. The standard version is limited to 65000 objects. The limit in Pythagoras Pro is 4 million objects.

Example: MAXIDS=65000

MAXUNDO

The maximum number of operation which can be undone. The limit is 25.

Example: MAXUNDO=3

EXT_DC_IMPORT

This parameter defines the standard extension displayed in the "Open File" dialog box when you want to import a data collector file.
Example: EXT_DC_IMPORT=DAT. The files with the extension ".DAT" will be displayed in the "open File" dialog box.

EXT_DC_EXPORT

This parameter defines the standard extension displayed in the "Save File" dialog box when you want to export a data collector file. (Stakeout list)
Example: EXT_DC_IMPORT=DAT. The files with the extension ".DAT" will be displayed in the "Save File" dialog box.

MOUSE_WHEEL_ZOOMING

This is where you specify whether the scroll-wheel needs to behave as a scroll-function or as a zoom function.

Values:

1 = zoom in/out
0 = Scroll

AUTOMATIC_BACKUP

This setting will determine whether Pythagoras automatically saves a spare copy upon opening a document.

Values:

0 = **no** automatic reserve copy
other = automatic reserve copy

AUTOMATIC_SAVE

This setting specifies whether or not Pythagoras should automatically save the drawing (while it is open) after a pre-determined time period.

Values:

0 = off
other = on

AUTOMATIC_SAVE_INTERVAL

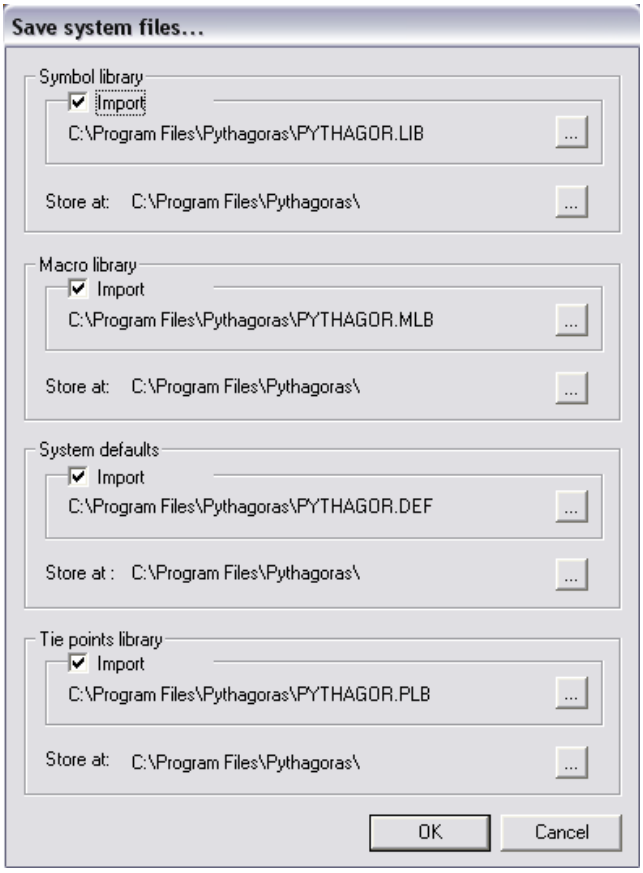
This specifies the automatic save interval in minutes.

CMDLINE

For internal use only.

Appendix E: Saving System Files

When starting up Pythagoras and pressing the CTRL-key, the following dialog box will appear:



This dialog allows you to perform the following actions to the system files (PYTHAGOR.LIB, PYTHAGOR.MLB, PYTHAGOR.DEF, PYTHAGOR.PLB):

- See the paths where Pythagoras system files are stored
- Specify other places to store these files
- Import system files obtained from other users/computers.

You can copy the system files from the indicated locations using any file managing program you like.

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